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Eng

SHIPWRECK BY LIGHTNING.

PAPERS

RELATIVE TO

HARRIS'S LIGHTNING CONDUCTORS.

Robert Bennet

BY R. B. FORBES.

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STATISTICAL RESULTS

Of an Analysis of the following 235 *Cases of Ships of the Royal Navy struck by Lightning, consisting of* 86 *Ships of the Line,* 70 *Frigates,* 61 *Sloops, and* 18 *other Vessels of various kinds.*

Destruction of Material.

There were damaged or destroyed in these cases 180 lower masts, of which 133 were the lower masts of ships of the line and frigates; 100 of these were ruined as masts. Of topmasts 172 were damaged and for the most part rendered unserviceable; at least two-thirds of these were topmasts of ships of the line and frigates; nearly all were destroyed.

Of topgallant-masts, about 140 were destroyed, nearly all belonging to large ships.

In addition to this we find a very serious amount of rigging and sails and other spars totally destroyed or ruined. See No. II.

Loss of Life.

In about 80, or one-third, of these cases, some of the crew were either killed or hurt; nearly 100 seamen were killed, about 250 dangerously hurt, most of whom had, of course, pensions; full 200 more were struck down on the decks — 20 to 40 at once. See No. III.

Fire.

In about 40, or more than one-sixth, of the cases, the ships were set on fire in some part of the masts, sails, or rigging, and placed occasionally in great peril.

Services of Ships.

Forty sail of the line, 20 frigates, and 10 sloops, in all 70 ships of the Navy, and averaging one-eighth of the ships in commission at the time, were disabled or placed *hors de combat* by lightning within the short period of five or six years. See No. IV.

In 30 at least of the 235 cases, that is, about one-eighth, the services of these ships were important; in some instances the cases were very critical.

Estimated Loss to the Crown.

The cost of material alone upon these instances could not have been much less than £150,000; the total loss to the Crown annually, on account of damage to the Royal Navy by lightning, could not upon a moderate estimate have been less than £6,000 in the last twenty-three years of the war, or much less than £2,000 in twenty-three years of subsequent peace.

INTRODUCTORY REMARKS.

An historical record of well-authenticated instances in which ships and vessels of the Royal Navy have been struck and damaged by lightning, under various circumstances, cannot but be of much philosophical and nautical interest, besides that it is really of great importance to a maritime power, such as Britain, to know the amount of damage its ships and fleets may sustain, at any given instant, by any of those powerful natural agencies to which they are constantly exposed, and to be enabled to calculate on the means of obviating such destruction in future. On the other hand, it is a main object of physical research to discover how and in what way any unknown power of nature, such as Electricity, displays itself, what is the amount of its mechanical or other action, and the meteorological or other changes attendant thereon. Such information, however, can be only obtained by a laborious and careful collection of facts such as will be found in the following history.

It is to be especially observed, however, that this record does not profess to comprise every ship of the Royal Navy damaged by lightning since the commencement of the last war about the year 1793, but only such cases as have been, by the liberal permission of the Lords Commissioners of the Admiralty, traced by a long and patient inquiry in the official journals of the ships. The frequent notices of such cases, accidentally derived from various sources, renders it highly probable that the greater portion of the ships engaged in active service since the year 1790, have been at some time struck and damaged by lightning. It is not always possible to trace through the bustle and turmoil of a long naval war, authentic accounts of such casualties, indeed they are not always recorded in the regular logs; whilst in

other duplicate logs of the same ship the casualty appears. The present list, however, is quite conclusive as to the large amount of damage by lightning in the Royal Navy, which has not only been of very considerable inconvenience to the public service, but of serious national importance.

The cases are arranged alphabetically, and numbered from 1 to 235; the language of the logs has been generally preserved.

PREFACE.

In 1848, I published a pamphlet on the subject of Lightning Conductors, as applied in the British Navy, by Sir W. Snow Harris.

The object which I had in view at that time was to arouse the attention of the United States Government and all those directly concerned in the protection of Ships from the destructive effects of the electric fluid, to the necessity of fitting them with a permanent and well-tested system of Conductors; the pamphlet has no doubt long since gone into the archives of waste paper and been forgotten, and my efforts to introduce Harris's Conductors into our Navy have, so far, (I trust only temporarily) failed, not from any want of appreciation of their value, but from a mistaken economy on the part of those who controlled the affairs of the Navy.

The recent destruction of the fine ship, the "Golden Light," affords an opportunity not to be lost of again calling the public attention to the necessity of fitting our first class Ships with Conductors. Should the present work meet with the same fate as the other I shall at least realize the satisfaction of having tried to do something towards mitigating the dangers incurred by those "who go down to the sea in ships and do business on the mighty waters."

The present work is offered to the public, like the other, gratuitously, but with the satisfaction of having received "material aid" in the publication, from the underwriters of Boston.

The following account of the loss of the Golden Light is from Capt. Windsor. He says:—

"The ship was struck by lightning on the 22d February, latitude 22° 23′ N., longitude 47° 49′ W., at about 9h. P. M.

"The fore-skysail-pole was finished off with a copper ball, gilded and secured to the centre of the mast by a copper spindle or bolt, about eighteen inches long, and perhaps half an inch in diameter; the electric fluid struck this ball and completely shivered the royalmast; the fore-topgallant-sail was furled at the time, and from the fact that no marks on the mast or elsewhere were found below the royalmast, it is supposed that the lightning passed down the *iron* topgallant-tyes and topsail-tyes and sheets into the between-decks and hold.

"The topsail-sheets, as usual, were single, and were rove through a leader in the thick work just before the main and foremasts. On each side of the after-part of the foremast were the chain-lockers, and the ends of the chains were, as usual, suspended to the cover of the chain-locker-hole or pipe. The fore hatch was near to the forward-part of the foremast, and on each side of it were stowed a quantity of pails or buckets packed in straw, while the hatch-way was filled up with bread, in bags; the ship had in the lower hold a quantity of anthracite coal. The stroke sounded like the discharge of many pistols close to one's head, but no one was aware, until about half an hour after the lightning struck, that the ship was on fire. At the time of the stroke, the second mate was standing near to the main rigging holding on to an iron belaying-pin, in the pin-rail, which rail, fore and aft, was coppered, to prevent chafes, as is common in many ships; he felt the shock so plainly that he thought that his arm was broken, and so stated at the time.

"The fore-hatch was removed as soon as possible, and efforts made to put out the fire, the ship being put before the wind; but it was soon found necessary to close the hatch and try to smother the fire, while preparations were being made to leave the ship in case the efforts to put out the fire should fail.

"The ship was filled with gas, and it is supposed that the lightning also ignited the coal at the same time that the cargo in the between-decks was set on fire.

"Finding the fire beginning to break out near the fore hatch, it was deemed prudent to leave the ship on the 23d, at 6h. P. M., in five good boats, well provided with sails and provisions; three of these were picked up on the 28th, at 7h. P. M., by the British ship Shand, of Liverpool, from Calcutta bound to this port, captain Christie, and landed here all well on the 20th March, after being most hospitably entertained.

"One boat has been heard from at Antigua, and it is supposed the other is safe as the weather was pleasant."

Capt. Winsor also says "much vivid lightning had been for some time about the horizon, and at the time the ship was struck, it was raining."

There were six passengers including two ladies and twenty-nine men and boys of the ship's crew, making thirty-five souls in all on board the Golden Light, twenty-three of whom were picked up by the ship Shand.

These are the principal facts relating to the loss of this ship and the fortunate rescue of her passengers and crew.

R. B. F.

Boston, March 25, 1853.

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SHIPWRECK BY LIGHTNING.

No. I.

An Authentic Account of some of the Ships of the Royal Navy struck and damaged by Lightning at various times, for the most part between the years 1793 *and* 1839; *compiled and abridged from the Official Log-Books of the several Ships: with Remarks by Sir W. Snow Harris, F.R.S., etc.*

1. Abercromby 74. 26th October, 1811.—At anchor, Basque Roads. A. M. Fresh breezes and squally, enemy's force 1 sail of the line and 3 frigates. P. M. 1h. 30m.; in a heavy squall, the fore-topmast was struck by lightning, which shivered the masts into splinters 14 feet down. The foremast also was struck and damaged.

N. B.—The foremast, by other accounts, was much damaged and afterwards shifted; the "Arrow" schooner disabled at the same time.

2. Achates 18. 26th Feb., 1812, lat. 45° 39′ N., long. 5° 38′ W., 12h. 10m. P. M.; main-topmast and main-topgallant-mast shivered in pieces, mainmast severely shattered, both pumps split, decks filled with a sulphurous smoke; main-topmast rigging cut and lost overboard.

The ship went to Plymouth and had a new mast.

3. Active 36. 19th Sept., 1802.—Gibraltar Bay, A. M. Heavy rain, thunder, and lightning, 9h. 30m. The lightning tore the sail from the larboard T. G. yard-arm, struck the main-topmast below the hounds, and shivered it in pieces; the upper part of the topmast, with topgallant-mast and topgallant-yard, fell on the main-top. The lightning passed down the mast, carrying away several hoops, and passing through mast coat, took a piece out of the bitts, and killed John Johnstone whilst cutting up the meat abreast of the pumps.

N. B.—Ship went into the Mole; had new fore and main masts; detained in the bay a considerable time.

The "Gibraltar" 80, and "Superb" 74, struck and damaged at the same time. Thus two sail of the line and a frigate were disabled in an instant.

4. ADVENTURE, Naval Transport. 7th April, 1850, at sea, lat. 4° 55′ N., long. 4° 2′ W., 2h. A. M. Thunder and lightning, which shivered the main-topgallant and royal masts, and completely ruined fore and main top-gallant sails, with other damage.

5. AFRICAINE 36. 1st Aug., 1803.—North Sea, Gravesant Steeple, S. E. b. E., four leagues; P. M. moderate and clear; 5h. heard the report of several guns; 7h. struck by lightning, which shivered the foremast, fore-topmast, and fore-topsail-yard. David Swords was struck dead off the fore-topgallant-yard, and several others wounded.

The ship was struck whilst furling topgallant-sails in a thunder-squall; one seaman was cut in two by the discharge, the others were paralyzed. The discharge appears to have gone right down the masts, shivering and splintering them in its course; at the deck it fell on some cases of shot stowed abaft the mast, and taking a direction along the booms went out of the ship in various places; a great portion out of the cabin windows. All the watch on deck were more or less affected by the shock, and from the alarm of fire they swamped the fore magazine.—*Further account by Capt. T. W. Nicholls, R. N., then in the ship.*

6. AGAMEMNON 64. 28th Nov., 1808.—Rio de La Plata, Isle of Lobos W. N. W. five miles. A. M. 4h. 20m.; lightning shivered the main-topgallant-mast and topmast, and starboard side of mainmast, and injured four men.

7. AJAX 74. 25th June, 1811.—Mediterranean, Isle of Gorgona, 4 leagues; A. M. 6h. 30m.; main-topmast shivered in pieces by lightning, mainmast much damaged also.

The ship fished the mast, which was afterwards taken out at Plymouth.

N. B.—The "Unite" 36, and "Resistance" 44, in company, struck and disabled at the same time. Thus a line-of-battle ship and two frigates, forming part of the Mediterranean fleet, were at once placed *hors de combat;* all these ships were obliged to go to Malta for refit.

8. ALBICORE 20. 7th August, 1798, lat. 17° 47′ N.; Point Morant, Jamaica, N. W. five or six miles; 4h. 20m. P. M. a discharge of lightning damaged the main-topgallant-mast, main-topmast, and mainmast, and wounded the main-yard. Weather moderate and cloudy, with rain and variable winds.

The ship went to Port Royal, where the mast was taken out.

Capt. T. White, R. N., who commanded the ship, gives an interesting account of this case. He says, "Whilst sitting in my cabin, between four and five in the afternoon, a sudden light glared round the mainmast, attended by a tremendous crash. It was then raining very hard. I instantly ran on deck, and found the mainmast shivered by lightning, and the topmast and topgallant-mast totally destroyed. The mainsail, which had been just furled, was also on fire. The mainmast

was rent down to the quarter-deck so far as the iron pump winches, which were disposed cross-wise."

9. ALBION 74. 30th Dec. 1818.—Malta; lightning struck the mainmast; the log does not record any serious damage.

10. ALBION 74. 5th July, 1822.—Portsmouth Harbor; 2 A. M. calm; main-topmast and mainmast struck with lightning, and much damaged.

N. B.—Ship under refit; the mainmast was taken out on the 11th.

11. ALEXANDER 74. 8th Sept., 1801.—Cape de la Mella, Mediterranean, N. N. E., off Toulon 12 leagues; 11h. 40m. P. M. a flash of lightning struck the main-topmast and shivered it in pieces.

N. B.—"Dragon" 74 struck the same day off Cape Furgons at 1 P. M. Thus two ships of the line, on the blockade of Toulon, were disabled at once.

12. AMPHION 36. 25th March, 1808.—Mediterranean; Island of Goza 5 leagues; A. M. 12h. 30m.; main-topgallant-mast and topmast shattered by lightning; mainmast damaged and set on fire; main-topsail, royal, and topgallant-studding-sails nearly cut in pieces, also the mizen and mizen-topmast staysails.

N. B.—The ship went to Malta for a new mainmast; under refit up to 2d April; services of ship lost for more than a week.

13. ARAB 22. 11th Oct., 1799.—Cruising about Nassau, West Indies; 1 A. M., the main-topgallant-mast and topmast were shivered in pieces by lightning, and the mainmast severely damaged. Three men killed and six men wounded.

6th; wind E. S. E., squally with thunder and lightning, and torrents of rain. The log describes the electrical discharges as "thunderbolts flying about the ship, two or three of which fell in the water within a cable's length of the ship," after which it dropped calm. The next day, 7th, a breeze sprung up from the W. with lightning, and increased to a gale; the wind on the 10th S. E., again moderate and fine; on the 11th, moderate and squally; at 1 P. M. a heavy squall with rain. In this squall the ship was struck by lightning; after this the wind flew in to the N. E.

The ship having repaired damages went to Port Royal, and had a new mainmast; she was detained for refit from the 18th November to the 29th December.

14. ARETHUSA 38. 4th July, 1811.—Sierra Leone, Coast of Africa; 2h. 45m. A. M. lightning struck the ship, shivered the main-topmast in pieces, and much damaged mainmast; several men at the pumps knocked down; the ship fished her mast and returned to Sierra Leone for refit; mast afterward shifted at Plymouth.

15. ARIADNE 28. 29th Dec., 1831.—Bermuda; 12h. 10m. A. M. heavy squalls, with thunder and lightning; mainmast and main-topmast struck by the lightning and both damaged.

N. B.—They unrigged the mast and got a new one; the topmast was found shook into laths.

16. ARMADA 74. 24th Feb., 1811.—Basque Roads, at anchor; A. M. strong gales, with thunder and lightning; a ball of fire struck the foremast, started one of the hoops, and did other damage.

N. B.—Ship was sent to Spithead for refit.

17. ARMADA 74, Plymouth Ordinary. 27th Feb., 1842.—Jury rigged, 9h. 30m. A. M. a heavy shock of thunder and lightning fell on the fore-topgallant-mast and shivered it a little above the rigging, split head of foremast, and passed over the side into the water, filling the ship with smoke.

18. ARROW 10, Schooner. 26th Oct., 1811.—Basque Roads; enemy's squadron S. by E. 5 miles; A. M. strong gales and squally weather; 1h. 30m. P. M. struck by lightning, which split the foremast; telegraphed H. M. ship "Abercromby."

N. B.—This vessel and "Abercromby" 74 were both crippled by lightning at nearly the same instant.

19. ATHOL 28. 27th Jan., 1831.—Bight of Biafra, Coast of Africa; midnight, fore-topgallant-mast shivered, head of foremast damaged slightly; the electric fluid passed down over the chain topsail-tye and sheets.

N. B.—The ship's lightning conductors were at this time in a box stowed below.—*Report, Shipwreck by Lightning*, p. 43.

20. AUDACIOUS 74. 4th Aug., 1810.—At anchor off Flushing; 5 A. M., heavy rain with thunder and lightning; 5h. 10m., the mainmast was struck by the lightning, followed by a tremendous peal of thunder; 5h. 15m., struck a second time and set on fire, broke two hoops and shivered the mast in several places; 6h. 15m. got down main-royal and topgallant-masts; found them, together with the maintopmast, much shivered, and several pieces split quite off.

N. B.—The ship was obliged to leave her station and go to Spithead, where she got a new mast.

21. BADGER 10. Chatham Ordinary. In the Medway, 1st Aug., 1822.—A. M., struck by lightning; foremast damaged, afterwards taken out.

22. BARFLEUR 74. 21st Oct., 1813.—Cruising off Toulon; 6 P. M., squally, with heavy lightning and rain; 9h. 40m. ship struck by lightning; on examining below, found the lightning had struck the gunner's store room and light room.

22d, A. M., found the fore-topgallant-mast, fore-topmast and foremast much damaged by the lightning; sent topgallant-mast on deck; 7 A. M., carpenters employed preparing a fish for the mast; struck fore-topmast and got it on deck.

The ship was obliged to leave her station, she went to Chatham for refit; the spars were quite ruined; five hoops were struck off the foremast; the electrical discharge passed through the gunner's store room, and forced open the door of the light room close to the magazine.

23. BELLEROPHON 74. 27th August, 1807.—Coast of France; at sea; Rochesbonnes N. W. 3 leagues. Fresh breezes and unsettled weather; 6 P. M., squally with heavy rain, thunder, and lightning; secured the pumps and magazines 6h. 25m.; a violent explosion of electric fire took effect in several parts of the ship at the same time; the main-topgallant-mast totally disappeared except the heel; the rigging was cut and burned in pieces; the main-topmast was shivered

from head to heel in a thousand pieces, part of it was forced into the maintop; the paunch on the fore part of the mainmast was ripped off, a part of it disappeared.

Another ball of fire struck the mizen-topmast and shivered it in pieces; the mizen-topgallant-mast and main-topmast-studding-sail-boom were both carried away. The electric fluid then descended down the mizenmast, burst open the hoops, and greatly damaged the mast; it then went through the quarter-deck, smashed all the glasses in the cabin, and then passed in an opposite direction through the bulkhead of the ward room; several persons were stunned, and a boy much injured; one man was killed on the poop, and eight wounded.

It appears by the Official Report from Captain Rotheram to Rear Admiral the Hon. Michael De Courcy, that a butt end of a plank was started in the ship's side; the clamps of one of the main deck beams cut, and a rider underneath split open.

24. Bellette 18. 24th May.—West Indies, at sea; 4 P. M., squally, with thunder and lightning; 5h. 30m., struck by the lightning, which split the main-topgallant-mast, splintered main-topmast, and wounded five men.

The rain fell in torrents, approaching in heaviness to a water spout; due precautions were accordingly taken in furling the sails, &c., and every one looked anxiously to where the clouds would burst and send forth their lightnings; all at once the wind died away, and a terrible burst of thunder and lightning ensued immediately over the vessel. Some curious effects were observed as the lightning shot towards the earth; it caused a noise similar to the whizzing of musket-balls. Again a breeze sprang up from the opposite quarter to the last direction of the wind, so that it became necessary to brace round the head yards. At this instant a discharge of lightning with thunder struck the ship, shivered the upper spars, and struck down thirty-six men who were hauling in the head braces, five of whom were seriously injured. The mainmast escaped damage.—*Account by Capt. Leath, R. N., who commanded the vessel at the time.*

25. Bittern 16. 23d Jan., 1844.—Angorha River, Coast of Africa; 10h. 20m. P. M., struck by lightning, which splintered the royalmast. The electrical discharge descended to the deck, and struck down several men; eight men were sent to the hospital.—*Surgeon's and Ship's Report.*

This vessel was fitted with conductors of wire rope, which appears to have carried off part of the shock.

26. Blake 74. 2d March, 1802.—Coast of France, at sea; 5 P. M., ship struck by lightning; main-topgallant-mast shivered from the sheave hole down for 12 feet; the rigging under maintop set on fire, two men slightly hurt.

27. Blazer, steamship. 20th March, 1839.—Near Beyrout, Mediterranean; 7h. 50m. P. M., main-cap split open, chain-peak and throat-halliards cut through, and partly fused, 30 feet of the planking of the sponsons on the larboard side blown out, one of the deck planks on the same side split and shivered; a quarter-deck rail of 4-inch Af-

rican oak shivered on the starboard side for 10 feet; all the iron stanchions started; a large hole struck through a boat hanging at the davits; the after-cabin filled with sulphurous smoke. Two persons on the deck knocked down.

The pieces of the chain halliards strewed the decks; the lightning broke a chain of half an inch in diameter on each side the mast; the engine was going at the time, and the lightning was seen to play about it in an extraordinary way.

28. BLOODHOUND 18. 2d Aug., 1812.—Western Ocean, at sea; A. M., 4h. 30m., strong breezes and squally, with thunder and lightning; 5h, 30m., was struck by lightning, which shivered the mainmast; 6 feet of it ripped out; carried away royalmast. Tore the main royal in pieces, and ruined the topgallant-sail; cabin stove in; all the watch on deck knocked down.

29. BLOODHOUND, Iron Steamer. 28th Oct., 1851.—Off Lagos, Coast of Africa, 8h. P. M. Fore-topgallant-mast and topmast shivered by lightning, which burned the galf-foresail, and partially destroyed the topsail and topgallant-sail; the sails looked as if destroyed by rats.

30. BRAZEN 28. 23d May, 1826. At sea, Cape Formosa N. by E. 133 miles; A. M., dark cloudy weather; 4h. 30m., a tornado; 4h. 50m., mizen-topmast and topgallant-masts shivered by lightning, and the mainmast also shattered.

They cleared wreck and repaired damages; got the mizen-top on deck.

31. BULWARK 74. 9th May, 1815.—Bermuda; A. M., 3h. 20m., the ship was struck by lightning, which set main-topsail-yard on fire. Beat to quarters 4h. 15m.; got the fire under by means of wet blankets; daylight down boats.

32. BUZZARD 10. 18th Sept., 1812.—Off Minorca, at sea; had charge of a Convoy; 6h. 30m., lightning struck the mainmast and shattered it very much, destroyed the flag at mast-head, and split starboard pump; secured mainmast with spare-topmast, and made sail for the Convoy.

The ship had a new mainmast at Mahon on the 26th.

33. BUZZARD, Brigantine. 27th Feb., 1838.—Coast of Africa; 7h. 50m. A. M., fore-topgallant-mast and topmast shivered; foremast damaged.

34. CALEDONIA 120. 24th Feb., 1811.—Basque Roads, at anchor, 8h. A. M., fresh breezes with rain; the ship struck by lightning, which damaged the foremast, rent fore-topmast from the head to the heel, and slightly affected thirty men. The ship went to Portsmouth for a new mast.

35. CAMBRIAN 44. 29th Jan., 1798.—A. M., strong gales and rain. A ball of fire struck the mainmast, divided two of the hoops under the hounds, and dissipated itself on the quarter-deck.

36. CAMBRIAN 44. 22d Feb., 1799.—English Channel; P. M., heavy squall from S. W., clewed all up 1h. 30m. A ball of fire struck the main-topmast, and divided one of the hoops of the mast, killed two

men, and wounded several others; bore up for Tor Bay; the discharge passed by the wet ropes into the waist, striking down almost every one on that side of the deck; the number of wounded men taken below, many of whom were insensible and apparently dead, was about twenty; one remained blind, another blind and speechless; the appearance of the ship was most distressing, nor could the men for many months after get rid of the impression produced on them at the time of the lightning. —*Further accounts of this and former case by Capt. Haydon, R. N., then in the ship.*

The "Fisgard" 44, distant about a quarter of a mile, was struck at the same time and all her sails scorched. See "Fisgard."

37. CAPTAIN 74. 27th Aug., 1809.—At sea, lat. 41° N., long. 41° W.; foremast shivered by lightning; four men killed and twenty-four struck down. All the logs do not record the full amount of damage.

38. CEYLON 50, Flag Ship, Malta. 8th March, 1839.—Foremast shivered by lightning, and pole-topmast; the electrical discharge fell on the fire engine, and was apparently dispersed on reaching some water in the bottom of it.—*Report, Shipwreck by Lightning*, p. 61.

39. CHANTICLEER 10. 18th Oct., 1822.—Corfu, at anchor; 3h. 15m., mainmast struck by lightning and rendered unserviceable; P. M., cut off mainmast 6 feet above the deck-rigged sheers, and got a main-topmast from Medina for a mainmast.

40. CHICHESTER, Revenue Cutter. 7th Feb., 1840.—Kilkenny Bay, Coast of Galway; 4 P. M., heavy squall W. S. W. with hail; a flash of lightning blazed over the vessel, attended by a terrific peal of thunder, broke the topmast in two parts, and knocked off head of mainmast, scooped out the mast obliquely and charred it, pierced the deck, and threw down the bulk-head between galley and cabin, and destroyed all the officers' berths; smashed all the dishes and glasses on cabin table, displaced all the heavy-iron grated skylights on the deck, raised the deck 6 inches off the beams, and threw out the bulwarks; filled the vessel with smoke, and destroyed the magnetic power of the compasses. On taking the vessel on the ground, it was found that the electrical discharge had passed through the bottom without damage to the timbers by means of the copper bolts in the frame, and had burst out the copper sheathing in various places opposite the bolts; two pieces of the sheathing blown off were nearly a foot square.

41. CLINKER 12. 31st Dec., 1828.—At sea; Coast of Africa, Fernandez Po 70 miles; A. M., 5h. 20m., brig struck by lightning; mainmast carried away 6 feet above deck, topgallant-mast fell on the larboard gangway, mast across the deck, sails went over the side; John Roberts, seaman, killed; daylight cleared wreck, found mast also carried away 8 feet below the cap, and the topgallant-mast fairly split in pieces; topmast shivered and the jaws of the boom broke. Went to Clarence Cove, Fernandez Po, for refit.

42. CLORINDE 44. 11th March, 1813.—Off Friar's Head, East Coast of Ceylon; P. M., wind westerly; 3h. 30m. struck by lightning; mainmast shivered from head to the deck; main-topmast cut in two; John Maitland and Thomas Hockley knocked overboard from

mast-head and killed; Joseph Hart killed in the top; five men wounded. Went to Trincomalee for refit.

43. COLUMBINE 16. 25th June, 1837.—Coast of Africa, Bembia Point N. E. 15 miles; P. M. 8h. 10m., fore-topgallant-mast shivered in pieces by lightning, fore-topmast-cap split open, one of forecastle beams damaged; the lightning ran down the chain-tye and sheets, split the blocks, ripped the copper off galley floor, and filled the ship with a sulphurous smoke; wind squally and variable with rain, thunder, and lightning, N. E. to N. W.

44. CONQUESTADOR 74. 12th May, 1814.—Port Royal Harbor, West Indies, A. M., 5h. 30m. Lightning struck the ship, split main-topgallant-mast in pieces; rent main-topmast and mainmast very much. Stripped the topmast, got maintop off, sent it on deck.

N. B.—Ship had a new mainmast on the 25th.

45. CRESSY 74. 20th Feb., 1812.—Off Dunnose, Isle of Wight; P. M., squally, with rain, thunder, and lightning; 8h. 10m., found mainmast very much damaged, having been struck by the lightning; got down main-topmast, and secured mainmast.

Went to Spithead for refit; received a new mast on the 28th.

46. CUMBERLAND 74. 27th Aug., 1810.—At anchor, Faro of Messina; 11h. P. M., squally, with heavy claps of thunder and rain; main royal-mast, topmast, and mainmast struck by lightning; maintop set on fire.

The mainmast was surveyed and condemned, but as the ship's services could not be dispensed with, it was fished.

47. CUMBERLAND 74. 2d Sept., 1810.—At anchor, Faro of Messina; A. M., 8h. 30m., heavy thunder and rain; main-topgallant-mast and mainmast again struck by lightning, which burst four hoops off mainmast.

Ship obliged to go to Malta for refit and a new mast.

48. CUMBERLAND 74. 25th Feb., 1812.—Bill of Portland N. N. E. 5 leagues; strong gales S. W., with heavy squalls, thunder, and lightning; P. M., 12h. 30m., main-topsail blew out of the bolt ropes; 1h. 40m., mainmast struck by lightning and set on fire; 1h. 55m., mainmast struck again with lightning. The ship went to Spithead and had a new mast.

N. B.—This ship had three refits and two new mainmasts within about 18 months, in consequence of strokes of lightning.

49. CURLEW 18. 15th May, 1821.—Trincomalee; P. M., 4h., heavy squall, wind shifting in all directions; 4h. 30m., fore-topgallant mast struck by lightning and carried away; fore-topmast also much damaged; foremast shook.

50. DÆDALUS 36. 13th Oct., 1809.—Port Royal, Jamaica, at anchor, under refit. A. M., variable light airs. 2h. 30m., squally from the land; thunder, lightning, and rain; 3h. very heavy thunder. At daylight found the starboard cheek and fish of the foremast very much splintered by the lightning, and one of the boat's davits carried away; examined the mast; found it requisite to take the mast out.

The ship, a day or two before, had been almost totally dismasted in

a squall, and was under refit, and had just had a new mast. The "Hebe" 36, struck and disabled at the same time and place.

51. DESIREE 36. 8th Oct., 1802.—Anchored in Port Antonio, West Indies; P. M., moderate and clear, wind S. E.; 9th, shifted to N. suddenly, with a heavy squall and tremendous thunder. Lightning struck the ship, completely shattered the main-topmast, and threw some of the pieces a considerable way inland; rent the mainmast from the head to the deck. 12h., storm abated. A. M., moderate breezes again from S. E. "Hebe" 36, No. 85, also damaged.

The ship fished the mast, and went to Port Royal for refit, where she had a new mainmast. The expansive force of the shock was so great, that a part of the main-topmast was found in a timber yard on one side of the harbor, and another piece was found sticking in the mud on the other side, full a quarter of a mile distant. This storm had not any considerable altitude; it was seen by an observer, from his house high up on the hill, as taking place immediately under him; over his head the sky was clear and tranquil.—*Private Journal of the late Admiral Ross, R. N., then Captain of the ship.*

52. DICTATOR 64. 8th Oct., 1794.—Fort Royal Bay, Martinique, at anchor; P. M., moderate and cloudy, with thunder and lightning. 6h. 15m., lightning struck our main-topgallant-mast and topmast, which were shivered in atoms; the mainmast also severely damaged in two places. Fished the mainmast.

The ship was in charge of a convoy for England, but was so disabled as to be laid up under refit for a week; the cross-trees and the cap of the topmast were completely struck off, together with topgallant rigging; the stump of topmast left standing, but so split open that it spread out like "a pair of compasses." Two days after the accident, smoke was seen to issue from the figure-head, which was immediately cut down; it was on fire in the heart of it; the wood was of elm.—*Statements by the late Capt. Couch, R. N., and the late Mr. Moore, Purser, R. N., both in the ship at the time.*

A circumstance of fire similar to this occurred on board the "Principe Real," a Portuguese ship of the line, bearing the flag of the Marquis de Niza, which was struck by lightning off Malta, in 1799, in company with H. M. S. "Audacious;" she went into St. Paul's Harbor in consequence; after having been anchored some hours, the mainmast suddenly burst out into a "flame of fire;" they were obliged to cut away the mast to save the ship.—*Lieut. J. Jeans, R. N., then serving in the "Audacious."* *

Many merchant ships have taken fire in this way a short time after being struck by lightning.

53. DISPATCH 18. 4th Jan., 1832. At sea, Cape Roca 45 miles. P. M., 2h. 15m., the ship was struck by lightning abreast of the main hatchway, which injured twenty of the crew.

54. DORIS. 8th Sept., 1808.—Kedgeree Roads, at anchor. A. M.,

* In the log of the "Audacious," 6th Nov., 1799, is a notice of the "Principe Real" struck by lightning.

moderate; at noon, sultry. P. M., cloudy; after which rain, thunder, and lightning; 8h. 20m., lightning struck with a dreadful explosion, and shivered and splintered main-topmast and topgallant-mast, and rent mainmast in several places; no one hurt.

55. DRAGON 74. 8th Sept., 1801.—Off Toulon; A. M., squally, with thunder and lightning. 1h. 25m., struck by the lightning, which carried away the main-topgallant-mast, sprung the main-topmast and the mainmast, and split the main-topsail. Fished the mast, and shifted the topmast.

56. DRAGON 74. 17th Oct., 1802.—Off Mahon, cruising; P. M., 2h. 30m., we were struck by lightning, which shivered main-topmast very much, and apparently damaged the mainmast.

57. DUKE 90. 17th June, 1793.—Engaged in the attack on Martinique. Moderate breezes and clear; laying to off Fond Capot. 2h. P. M., landed 3 officers and 77 men belonging to the 29th Regiment; 4h., made sail to the northward, in company with "Hector," "Iphigenia," and "Ulysses." 5h., heavy rain and squally. Several shot and shells fired at us from the batteries; at 5h. 40m., the battery on the Point à la Mer began firing on us, which cut one of our mizen shrouds. 6h., began firing on the battery on the Point à la Mer, which was soon deserted. Steered down towards the village La Precheur, and received several shot from the batteries, which wounded our mizenmast. 6h. 30m., began firing at the batteries and silenced them; sent the master to sound for anchorage; weather cloudy and calm, with much lightning; 9h. P. M., thunder and rain. 10h. 30m., a ball of lightning, with a tremendous peal of thunder, struck our main-topgallant-mast-head, and shivered the topgallant-mast and topmast into small pieces, which strewed the decks. Mainmast also damaged in several places, and split in the centre piece to within 14 feet of deck; hoops and wouldings of mast burst open; starboard pump case split, and the pump chain broke in many places; split the geer bit on the middle gun-deck, luckily no one was hurt; 1h., thunder ceased.

18th. 5h., A. M., began to clear wreck, found main-topsail-yard lying across the collar of mainstay, and the sail much torn; the mizen-topsail and staysail were also much torn. Tacked ship; employed clearing wreck.

The mast was so disabled that they were obliged to cut it down to a stump, and rig a jury-mast. The ship came home to Plymouth in November for refit. The account in the log is written after the action, during which the ship had been disabled.

58. EAGLE 74. 22d Nov., 1811.—Adriatic, Sassena E. by S. 10 miles; A. M., strong breezes, with rain, thunder, and lightning, which struck the foremast and wounded one man.

59. EAGLE 74. 14th Jan., 1812.—Antipaxo N. E. 4 miles; 8h. 20m. P. M., a heavy squall; lightning struck the mainmast, burst off one of the hoops, and wounded ten men.

60. EAGLE 74. 21st Jan., 1812.—Off Corfu; struck by lightning in the morning; mainmast twice struck and set on fire.

Admiral Sir Charles Rowley, who then commanded the ship, de-

scribes these cases of lightning as having been extremely awful and distressing. He was himself knocked down by a bolt which was struck out of the tops; one man in a Guernsey shirt was scorched black all over, although the shirt remained untouched: this is a curious instance of the conducting power of the human frame in defending the woolen substance. The sails, rigging, and spars were all more or less damaged; so many men were struck down that the crew became terrified at the effects produced by the electrical agency; it was only by great exertion on the part of the officers that the fire was got under and order restored. The ship was for a short time in great jeopardy and likely to have been burned.

61. EDGAR 74. 30th Oct., 1798.—Off Cadiz; 8h. P. M., heavy gales; 9h. 30m., our main-topmast, main-topgallant-mast, and main-topsail-yard-arm were carried away by lightning; several of our men hurt, and the mainmast damaged; A. M., moderate; found mainmast sprung; signalized the Admiral; fished the mainmast, &c.

62. EGERIA 20. 23d April, 1817.—At sea; lat. 41° 30′ N., long. 60° 26′ W.; P. M., light airs and variable; 12h. 15m., unsettled and squally, S. E.; 3h. 35m., very black in N. W., with forked lightning; 4h., clewed up the sails, and ordered all the men to come down from aloft; 4h. 15m., lightning struck the mainmast and exploded on main-deck; knocked down several men; found the main-topgallant-mast shivered at the heel, and the foot of main-topsail rent; the fore paunch of mainmast torn away, and four of the large clasp hoops and the mast coat ripped up; upper part of the larboard chain-pump much injured; found also main-topgallant-sail much torn and burned, and the yard quite gone.

63. ELEPHANT 74. 24th Nov., 1790.—Portsmouth Harbor, 11 P. M., main-topmast shivered in pieces; mainmast shaken and splintered from the hounds downward; hoops of mast burst open, wouldings much burned, hand-pump broken, back casing of chain-pumps burned.

The shivers of the topmast were forced from the heel, and in falling one of them broke off the head of the mizen-topmast lying on the booms. The ship had a new mainmast.

The same discharge of lightning also fell on the "Prince William" sheer hulk, and destroyed one of the sheers.

64. ELK 10. 22d July, 1814.—At sea, lat. 29° 40′ S., long. 35° 21′ E., A. M., fresh gales and squally, heavy lightning with rain; 6h. 30m., foremast struck with lightning, which splintered the mast and wounded four men; after the lightning at 1h. 30m. P. M. a sudden shift to S. W., in a sort of whirlwind which took the ship all aback, and nearly swamped her over the stern; 23d, dark squally weather, wind varying from S. W. to S. S. E.; P. M. calm and cloudy, after which a heavy squall from N. W.

The electrical discharge fell on the head of fore-topmast and burned the eyes of the rigging about the mast-head, which appeared as if seared with a red-hot iron. The foremast was so shaken as to require strong wouldings and fishes; still whenever the headyards were hauled

it rattled like a bundle of laths. The discharge, after shaking the foremast, passed over the forecastle deck into the sea. Two of the men injured lost the use of their limbs.

The author is indebted to Mr. Gowdy, the Master, for further details of this case.

The lightning conductor was got up to the mainmast after the accident.

If the ship had been fitted with permanent conductors all this would not have happened.

65. ENDYMION 44. 13th April, 1806.—Off Cape St. Vincent, 6h. P. M., squally; the mainmast struck by lightning; mainsail set on fire; extinguished the fire; found the mainmast much shook and several of the hoops off.

66. ENDYMION 44. 21st March, 1842.—At Calcutta, off the fort; A. M., vivid lightning, with heavy thunder; daylight found the fore-topgallant-mast and topmast badly shattered by lightning, and the foremast damaged.

Wind W. N. W., N. E., S. E., S. W., and variable.

The storm began in the evening, when a common conductor was got up to the mainmast; about 4 A. M. an explosion of lightning took place in the ship, and struck on the main deck, near the galley. After this, the damage forward was discovered; the fore-topgallant-mast was shivered from the royal sheave to the cap; topmast from the catharpins to the cap, nearly destroyed; rubbing panch of foremast started, and pieces taken out of mast between hoops; lower end of the cheeks splintered.

The foremast was fished; the ship being to sail for China, her services could not be delayed; the topmast could not be replaced except by a teak topmast; the damage was found extremely inconvenient, as it occurred just at the moment the ship was about to sail to join the China expedition. The conductor on the mainmast did not save the foremast; hence the necessity of a conductor for each mast. See "Racer" also, No. 155.—*Further account from Capt. the Hon. F. Grey, who commanded the ship.*

67. EOLUS 36. 14th Dec., 1808.—Lat. 29° 38′ N., long. 9° W., West Indies; A. M. 10h. 30m., squally, with heavy rain, thunder, and lightning; fore-topgallant-mast shivered in pieces, foremast damaged; the weather on the previous days had been moderate and cloudy, with light airs from the S. and variable; 13th, P. M., a westerly swell, midnight.

It appears by the log that the fore-topmast was also damaged; it was shifted on the 16th.

68. ESK 18. 1st Nov., 1827.—Coast of Africa, lat. 5° N., long. 5° E.; at anchor, river Bento 44 miles; main-topgallant-mast shivered; main-topmast slightly splintered.

The weather had been fine and moderate, with southerly and westerly winds. Nov. 1st, A. M., W. to W. N. W.; P. M. 3h. 30m. a heavy tornado with thunder, lightning, and rain; 8h. P. M. moderate and cloudy; midnight fine; wind remained westerly.

A schooner prize was struck by a terrific discharge of lightning at sea, on her passage to Sierra Leone; the fore-topmast was knocked in pieces; the foresail set on fire, as also the hull; the deck was ripped up, and all hands thrown down. Another prize, a ship, was struck first on the mizen-topmast; afterwards on the main-topmast, and both rendered useless; one marine killed.—*Report on Shipwreck by Lightning*, p. 85, *and ship's log.*

69. ETNA 10, Bomb Ship. 5th Jan., 1830.—Corfu Channel, Mediterranean; 8h. P. M., moderate breezes N. N. W., with lightning, thunder, and heavy rain; the electrical discharge burst over the forecastle, and one of the Marine Artillery was struck down and much hurt; it descended to all appearance like a rocket or shell, and exploded close to the foremast, about 12 feet above the forecastle with a terrific noise, without injuring the mast; all the men on the forecastle were stunned or knocked down by it.

The ship had the common chain conductor at the main, which was too short to reach the water by 6 feet; the electrical discharge struck upon it several times and terminated at its extremity by loud explosions, one of which "shivered the upper glazed half port near it."—*Report of Commission on Lightning Conductors.*

The ship had only one chain conductor on the mainmast, and not any on the foremast; many parts of the chain exhibited marks of fusion, especially at the junction of the links, some of which were nearly if not wholly separated; the ship was at the time shortening sail previously to coming to an anchor in company with "Madagascar" and "Musquito."

70. FANNY, Cutter, Tender. 30th July, 1851.—Off St. Helens, Isle of Wight; heavy thunder storm; lightning struck the topmast and shook it into laths; split and ruined the mast, stunned two men.

The cutter had been sent out by the Admiralty on service; was laid up after for refit.

71. FISGARD 36. 22d Feb., 1799.—English Channel, off Plymouth; P. M., heavy squall with rain; ship struck by lightning, which scorched the sails and turned them black; the electrical discharge appeared to blaze over the wet ropes and sails; "Cambrian" 36 struck at the same time, distant about a quarter of a mile.—*Ship's Log, and Statement by Admiral Sir T. B. Martin, R. N., who then commanded the "Fisgard."*

72. FOUDROYANT 74. 4th Nov., 1799.—North End of Goza 4 leagues; A. M., three sail in sight; made sail in chase; 3h. shortened sail; rain, thunder, and lightning; 6h., the fore-topmast and topgallant mast were shivered in pieces; William Gordon, seaman, was killed, and several men wounded.

73. Fox, Revenue Cruiser, Cutter. March, 1818.—Off Plymouth; mainmast struck, and damaged from cap to boom-saddle; mast replaced at the Plymouth Dockyard, 6th March.—*Dockyard Returns.*

74. FREDERECKSTEIN 32. 1st March, 1812.—At anchor in the Pirœus; P. M., a thunder storm with heavy rain; a flash of lightning struck fore and main masts, damaged main-topmast, splintered cheeks

of the mast, and burst one of the hoops; a fire-ball seemed to explode over the deck, which set the studding-sails on the booms on fire; some of the sails aloft also much burned; main-topsail set on fire, which was with difficulty extinguished; two seamen on the forecastle stunned.

75. GALATEA 44. 7th July, 1805.—Working into Prince Rupert's Bay; P. M. 1h. 30m., a heavy clap of thunder and lightning struck the ship, considerably damaged the masts, and wounded five men; 6h., anchored; employed repairing damage.

76. GIBRALTAR 80. 19th Sept., 1802.—Gibraltar Bay, 9h. A. M., foremast, fore and main topmasts struck by lightning and much damaged; three seamen wounded; all the hoops on the foremast were started, and came down on deck; the lightning is said to have assumed the appearance of a fire-ball: it passed below, and exploded in the gunners' store-room, with a report like a cannon. A man who sought shelter near the foremast was scorched along his back; his clothes, consisting of two shirts, (one of them flannel,) waistcoat, jacket, and great coat were all completely burned through to his skin.

This electrical storm, like many others, appears to have taken place on the meeting of opposite currents of air; it did considerable damage to the fleet in the bay; H. M. ships "Active" and "Superb" were both struck at the same time; and thus were three important ships of the Mediterranean squadron damaged or disabled in an instant.

The "Active," as already stated, was supplied with new fore and mainmasts, whilst this ship, the "Gibraltar," had to get a new foremast.

77. GLATTON 54. 20th May, 1794.—Off the Cape of Good Hope; P. M., fresh gales and cloudy; 3h., squally, with lightning, which shivered the mizen-topgallant-mast and topmast, disabled the mizenmast, and did considerable damage below; "Lion" 64 in company; they sent carpenters on board to assist in repairing damage; the "Lion's" mizenmast also damaged.

78. GLORY 98. 17th July, 1805.—Cape Finisterre N. N. E. 30 leagues; 6h., A. M., reefed; tremendous thunder, lightning, and rain; 10h., found main-topmast shivered and rent, main-topgallant-mast carried away, main and fore-topsail split, and the mainmast damaged in several places; panch on fore part of the mast knocked in pieces, and the mainsail split; shifted main-topmast.

This damage happened just before Sir Robert Calder's action in which the "Glory" was engaged; all the carpenters in the squadron were employed in giving the mast a temporary repair, so as to enable the ship to join the admiral off Ferrol: a case of critical emergency.

The following account of this disaster, from the pen of a naval officer, then a midshipman in the ship, is highly interesting and important; he says, "The accident occurred only four days before Admiral Sir Robert Calder's action with the combined fleets, and when it is remembered that the combined fleets under Admiral Villeneuve was superior to the British fleet in numbers, the absence of a 98 gun ship such as the 'Glory' would have been severely felt."

"On the 18th July, at 9, A. M., we had tremendous thunder and

lightning, wind and rain; whilst reefing the topsails, the ship was struck by lightning, which carried away main-topgallant-mast, shivered the main-topmast, and so seriously damaged the mainmast that it was with difficulty secured for any further service; the mainsail, fore and main-topsails were split, and almost every man in the maintop more or less injured."—*Nautical Magazine*, 1849, p. 161.

This ship bore the flag of Rear-Admiral Stirling, and was on its way with four sail of the line, to reinforce Vice-Admiral Sir Robert Calder, a case of emergency.—*James's Naval History*, vol. iii. p. 301.

79. GLOUCESTER 74. 2d Aug., 1830.—Malta; 9h. 25m. A. M., main-topmast shivered by lightning; mainmast badly wounded from the trestle-trees to the quarter deck; topgallant-yard damaged.

The wind had become variable, all round the compass; 3h. 30m. A. M., squally, with rain, thunder, and lightning; 11h. A. M., the storm abated.

The ship was obliged to refit and have a new mainmast; she was detained until the 7th of September. H. M. ship "Melville" was also severely damaged in the same storm, and obliged to shift the mainmast. Thus were two sail of the line disabled at once: they were perfectly ready for sea, and were about to sail to join the Admiral.

80. GOLDFINCH 10. 17th June, 1811.—Basque Roads; 5h. A. M., lightning struck the ship, and shivered the foremast, topmast, and topgallant-mast; set fire to the mast and sails, part of which were cut away to save the ship; 6h. P. M., warped alongside the "Poictiers" 74, and took the mast out.

81. GOLIAH 74. 29th Aug., 1802.—West Indies, lat. 23° 40′ N., long. 74° 30′ W.; P. M., squally, clewed up the topsails; 7h. 40m., a flash of lightning struck the fore-topgallant-mast and shivered it, as also the fore-topmast, in pieces; splintered the foremast; killed two men and wounded thirteen; 8h., fore-topmast, with top-gallant-mast, yard, sail, and boom, went overboard; all hands employed clearing wreck.

The electrical discharge descended by the mast into the fore light-room, split the bulk-head of the magazine, and destroyed several lanterns; on opening the door of passage to magazine, the smell of sulphur was intolerable, and excited great alarm.

This happened about the time of the French Expedition to St. Domingo; the ship was obliged to go to Halifax for a new mast and refit.

82. GORGON 6, Steam Frigate. 11th Dec., 1840.—Marmorice Bay; at anchor, main-topmast rent by lightning.

83. GUERRIERE 36. 16th March, 1811.—Off Charleston; 4h. A. M., squally, with heavy rain, thunder, and lightning; found fore and main-topmasts damaged by the lightning; the electrical discharge passed down the aft side of mainmast in direction of the wedges, and tore a piece out of it.

It is stated in one of the editions of James's "Naval History," that this vessel went into action with the large American frigate "Constitution" in August, 1812, with her mainmast in a crippled state from lightning; the log does not record considerable damage to the main-

mast, yet from other accounts it appears that the mast was very much shook, and was found by Captain Dacres, when he took command of the ship, in a very defective state; it was continually getting worse up to the time of the action, in the course of which it broke down.

84. HAERLEM 74. 3d Dec., 1800.—Mediterranean, Cape Nicola S. W. 4 leagues; 6h. A. M., squally, with heavy rain; lightning struck the main-topmast, shivered it quite through, followed the direction through the mainmast down to the upper deck, where it burst with a great explosion and scorched a man's back; mast damaged in various places, and very much scorched; three of the iron hoops burst open.

N. B.—The ship went to Malta for refit, but her services being much required as a convoy, the mast was for the time patched up by fishing it.

85. HAZARD 18. 1st May, 1846.—Diamond Point, Sumatra; A. M., 3h. 35m., in royals and flying jib; 5h., set topgallant-sails; 7h., ship struck by lightning, which split masthead vane-staff, and carried away the conductor, and damaged main-topsail sheet bitts; the lightning passed down by main-topsail chain-sheets, and by wire conductor, tore the copper to which it was attached off the ship's side, and materially injured the wire by breaking the strands.

86. HAZARD 18. 12th June, 1846.—Cape Po, Sarawak, Borneo; at anchor; 5h. 30m. A. M., lightning struck the ship, splitting and carrying away main-topgallant and royal masts; the whole of main-topmast from hounds to lower cap, sprung after cross-tree, split and carried away starboard trestle-tree; the electric fluid partly escaped down the conductor by main rigging; part of topmast stove in the quarter-deck and went into gun-room; 8h., cleared wreck.

N. B.—This was one of the ships in which temporary wire conductors were fitted for trial, in order, as stated in the letter from the Secretary of the First Lord of the Admiralty, dated 7th November, 1840, that experience might determine which "of all the plans would be preferred."

87. HAWK, Revenue Cutter. 1st Jan., 1840.—Broadhaven, N. W. Coast of Ireland, at anchor; 9h. A. M., topmast and lower mast struck and shivered by lightning.

The wind was westerly, blowing a heavy gale, the sky became overcast by a dense black cloud, which seemed to be rent asunder by a burst of vivid fire. It was observed by those on shore to fall on and envelope the vessel in a flame of lightning, and she appeared to yield to a crash of the thunder; the copper spindle was melted; the lightning, after descending by the mast, exploded violently between decks, and passed into the sea by the chain cable; all the berths, and the vessel below, were filled with a thick sulphurous vapor of a suffocating odor; the discharge passed down the main hatchway between a man and a boy.

About the same time a discharge of lightning burst over the "Neptune," a small cutter, in Ely Bay, about 12 miles to the southward, and struck the sea so near the vessel as to cause her to reel considerably; several of the crew were stunned by it.

88. Hebe 36. 13th Oct., 1809.—Port Royal, West Indies, at anchor; A. M., variable, with thunder; found main-topmast and royal-mast shivered by lightning; shifted the spars.

This ship struck in same storm with "Désirée," No. 51; so that two frigates on the West India station were at the same instant crippled in their spars.

89. Helder 64. 24th June, 1811.—Off Copenhagen, 10h. 30m. P. M., mainmast shivered from truck to the deck; obliged to anchor.

90. Helicon 18. 25th Feb., 1812.—Plymouth Sound, at anchor, 11h. 30m. A. M., slight damage; one man wounded.

91. Herald 20. 4th July, 1815.—Off Chagres, 1h. A. M., main-topgallant and topmast rent in splinters; mainmast severely damaged; sails torn.

92. Heron 18. 9th March, 1828.—Buenos Ayres, at anchor, 10h. 45m. P. M., foremast ruined, fore-royal burned; ship sent to Rio for refit.

93. Hibernia 120. 2d Aug., 1813.—Gulf of Foz, at anchor, 3h. A. M., foremast and main-topmast damaged; two men wounded.

94. Hind 20. 20th May, 1800.—New Providence, 10h. A. M., main-topgallant-mast, topmast, and mainmast shivered and set on fire; ship disabled.

95. Hyacinth 18. 23d Sept., 1833.—Indian Ocean, 4h. 30m. A. M., fore and main-topgallant-masts and topmasts shivered in pieces; foremast head rent.

96. Hyacinth 18. 13th May, 1838.—At Penang, 5h. 30m. A. M., main-topgallant-mast and topmast shivered in pieces.

97. Hydra 36. 14th May, 1808.—Off Sicily, 5h. 35m. A. M., mainmast shivered from truck to deck; sea covered with the splinters; went to Malta for refit.

98. Implacable 74. 8th July, 1810.—Off the Isle of Wight, 7h. A. M., all three masts struck; fore and mizen-topgallant-masts damaged; fore-topmast damaged; one man hurt.

99. Isis 36. 24th August, 1777.—At anchor, Howell's Point, 8h. 30m. P. M., main-topgallant-mast and topmast knocked in pieces; mainmast damaged; topmast shrouds burned. Had charge of convoy.

100. Jackall 6, Iron Steamer. 15th January, 1852.—Coast of Africa, main-topmast shivered in pieces; other damage.

101. Kent 74. 31st July, 1811.—Off Toulon, 4h. 15m. A. M., main and mizenmasts, and topmasts and mizen-topgallant-mast shattered; mainmast set on fire, and quite ruined; one killed, two wounded.

102. Larne 20. 16th Feb., 1820.—Off Corfu, 7h. A. M., mainmast damaged; several men knocked down; one killed on the spot, one died soon after.

103. Lavina 44. 6th May, 1807.—Vigo Bay, mainmast struck; slight damage.

104. Leda 44. 17th July, 1813.—East Indies, A. M., 9h. 50m., main-topgallant-mast shivered, mainmast injured, a sail set on fire.

105. Leviathan 74. 9th Oct., 1812.—Gulf of Lyons, main-topmast rent by the lightning; mainmast slightly damaged.

106. Lion 74. 20th May, 1794.—Off the Cape, struck, together with the "Glatton" 54; mizenmast destroyed, and other damage.

107. Lively 36. 24th Nov. 1805.—Naples Bay, 11h. P. M., mainmast damaged; ship had a new mast at Malta.

108. La Loire 38. 2d Jan., 1809.—Cadiz Bay, 10h. A. M., mainmast damaged; one man hurt.

109. Lowestoffe 36. 8th March, 1796.—Mediterranean, P. M., 12h. 30m., main-topmast and mainmast shivered; fore-topmast split; ship set on fire in various parts of mast and rigging; three men knocked off the mast-head, two killed; obliged to cut away the mainmast. See No. IV.

110. Lynx 10. April 1840.—Off Lagos, fore-topgallant-mast and topmast damaged and shattered; struck in a tornado.

111. Madagascar 50. 5th Jan., 1830.—Corfu, 8h. 30m. P. M., mizen-topmast and mainmast severely damaged; maintop set on fire; ship struck five times in the course of an hour.

112. Magnificent 74. 17th April, 1814.—Off Ushant, 8h. P. M., main-topgallant-mast disappeared; topmast shivered; mainmast damaged; decks covered with splinters; rigging destroyed; many struck down.

113. Medina 20. 9th Jan., 1830.—Coast of Africa, 12h. 40m. P. M., main-topgallant and topmast shivered in atoms; mainmast much injured.

114. Melpomene 44. 17th December, 1805.—Coast of Spain, explosion in the ship; one man hurt; main-topmast went over the side; severe gale.

115. Melville 74. 2d Aug., 1830.—Malta, 9h. 15m. A. M., main-topgallant and topmast split and shivered; mainmast damaged; had a new mainmast.

116. Mercury 28. 24th Feb., 1801.—Mediterranean, 2h. P. M., mainmast shivered; obliged to go to Mahon.

117. Mignonne 18. 4th July, 1804.—West Indies, 1h. A. M., main-topmast shivered, and scattered in all directions; mainmast split to the keelson; five killed, one wounded.

118. Milford 74. 23d Jan., 1824.—Plymouth Ordinary, 6h. A. M., jury mainmast and topmast shattered.

119. Minerva 36. 26th Aug., 1811.—Bay of Biscay, fore-topgallant-mast and topmast shivered in pieces.

120. Minerva 36. 9th Nov., 1791.—Coast of Malabar, at anchor, 2h. 30m. A. M., topgallant and main-topmast shivered; fell about the decks; mainmast rent; one killed, two wounded.

121. Monmouth 74. 21st Aug., 1802.—Naples Bay, 7h. A. M., main-topgallant and main-topmast rendered useless; mainmast damaged severely.

122. Morgiana 18. 27th Feb., 1814.—West Indies, 7h. P. M., mainmast splintered; three men wounded.

123. Mosquito 10. 5th Jan., 1830.—Corfu, with "Madagascar" and "Etna," 8h. 30m. P. M., some of the sails set on fire.

124. Narcissus 36. 23d April, 1816.—Off the Western Islands,

main-topgallant-mast and main-topmast shivered; also mainmast in several places; main-topsail set on fire; men blinded at the halliards.

125. Nereus 36. 22d March, 1814.—Rio de la Plata, at anchor, 8h. 15m. P. M., main-topgallant and topmast shivered; mainmast severely damaged; main-topsail and mizen-staysail destroyed.

126. Nieman 36. 29th June, 1814.—Halifax, 12h. 45m. A. M., main-topmast and mainmast ruined; mast shifted.

127. Norge 74. 3d June, 1815.—Port Royal, 4h. A. M., main-topmast and topgallant-mast shattered; mainmast disabled; also mizen-topgallant and topmast; could not sail for the protection of a convoy.

128. Ocean 98. 2d Sept. 1813.—Off the Rhone, at anchor, main-topmast destroyed; mainmast broken; ship went to Mahon for refit.

129. Ocean 80. 12th March, 1829.—At Smyrna, 1h. A. M., main-topgallant-mast and topmast severely damaged.

130. Opossum 18. 23d March, 1815. English Channel, 10h. P. M., struck in the main rigging; slight damage; oblique discharge.

131. Orlando 36. 31st Jan., 1813.—At Smyrna, 12h. 30m. A. M., main-topmast shivered; head of mainmast destroyed; mast ruined; ship sent to Malta.

132. Palma 48. 12th June, 1814.—Carthagena, 9h. 45m. A. M., fore-topgallant and topmast knocked over the side; lower mast damaged; one killed, six severely hurt, many injured.

133. Pegasus 32. 19th Dec., 1787.—Cork Harbor, 3h. 30m. A. M., main-topgallant-mast shivered; mainmast damaged. Ship commanded by his late Majesty William IV.

134. Pelican 18. 10th Sept., 1806.—Off Belize, at anchor, 3h. A. M., main-topgallant and topmast destroyed; lower-mast much damaged.

135. Pelican 18. 18th Nov., 1837.—River Bonny, 4h. 30m. A. M., fore-topgallant and topmast shivered; foremast crippled; topgallant-sail and royal set on fire and burned.

136. Pelican 18. 26th Feb. 1835.—Off the Isle of Wight, 9h. 45m. P. M., fore and main-topgallant-masts struck; fore-topmast and foremast damaged.

137. Perseverance 36. 11th Sept., 1789.—Bay of Bengal, 6h. A. M., topgallant-yard partly destroyed; foremast ruined in the heart; two men fearfully burned, many wounded.

138. Phæton 46. 14th Sept., 1824.—Gibraltar Bay, 8h. P. M., fore-topgallant-mast and topmast destroyed; head of mast set on fire, and completely disabled; several sails set on fire; hearts of the masts torn out; cut the foremast off thirteen feet above the deck; rigged a jury-mast; went to Spithead. See No. IV.

The following is an extract from Capt. Sturt's letter to Admiral Sir George Martin, dated on board H. M. Ship "Phæton," Spithead, 21st October, 1824:—"From seven to eight, P. M., it blew extremely hard in squalls, with vivid flashes of lightning; a few minutes before eight, a condensed black cloud was observed to glide along the side of the rock, and, directing its course towards us, exploded at ten minutes past eight, with a terrific crash, directly over the 'Phæton;'

striking first the fore-topgallant-mast, it descended down the topmast to the foremast and bitts, all of which were shivered in pieces, and set on fire, together with the small sails in the top, and the topmast studding-sail in the larboard rigging.

"The electric fluid likewise struck the main-topgallant-mast, came down the signal-halliards, which were burned to cinders; the very hearts of the masts were torn out, and five of the iron hoops on the foremast partially melted and torn asunder."

"Tuesday, 14th Sept., P. M. 8h., fresh breezes and cloudy, with lightning and thunder. Ship struck by lightning, which rent the foremast, fore-topmast, topgallant, and royalmast; set fire to the fore-topmast-head and fore-topgallant and lower studding-sails. Beat to quarters, and extinguished the fire."

The 14th and 15th were employed in making good defects: the foremast was cut off sixteen feet above the deck, and a spare main-topmast rigged as a jury-foremast; after which the ship was obliged to leave her station, and return to Portsmouth for refit.

Such were the effects of a discharge of lightning on the "Phæton," similar to that which fell on the "Fisgard," proving incontestibly the truth of the concluding remark in Captain Duntze's letter, that, "but for the efficiency of the conductors, the mainmast of the "Fisgard" must have been totally destroyed, and much other serious damage have occurred."

Any unbiased person, therefore, who considers attentively the history of such cases of lightning, must reasonably admit that they have a conclusive and important bearing on the interests of the Navy; and evidently show that, by a proper arrangement of metallic conductors, ships may certainly be guarded against the destructive effects of an element which, as shown by the records of Her Majesty's ships for a long series of years, have continued to deprive the country of the full services of its fleets, destroying its sailors, and wasting its treasure; thereby frequently placing the national interest in a critical position. If, in time of war, the "Fisgard" of 42 guns had been disabled and had lost her mainmast on a foreign station, such as the Oregon, the consequences might have been most serious, to say nothing of the difficulty, inconvenience, and expense of supplying a new mast at so great a distance from England.

139. PHŒNIX 36. 20th Feb., 1816.—Mediterranean, 2h. A. M., mainmast damaged.

140. PHŒNIX 36. 25th Feb., 1801.—Mediterranean, 2h. P. M., one killed; many hurt.

141. PIQUE 36. 24th Oct., 1839.—River St. Lawrence, 1h. A. M., foremast damaged just under the top. Mast subsequently taken out.

142. POMONE 44. 27th Jan., 1796.—Plymouth, 1h. P. M., foremast ruined and taken out; topmast stay-sail set on fire. Ship had just refitted.

143. POMONE 44. 13th Nov., 1811.—Off Tavoloro, 9h. 30m. P. M., fore and mainmasts struck; main-royal burned; one killed, four wounded.

144. POMONE 44. 21st Dec., 1806.—Off Weymouth, 6h. 30m. A. M., foremast damaged; all the men before the mainmast struck down; many injured severely.

145. POMPEE 74. 11th Oct., 1812.—Gulf of Lyons, 3h. 30m. A. M., fore and main-topmasts disabled; main-topgallant-mast shook in pieces; one killed, one wounded.

146. POWERFUL 80. 25th March, 1840.—In Vourla Bay, at anchor, (near the "Asia" 84,) 12h. 56m. A. M., fore-topgallant-mast and topmast shivered, foremast damaged. "Asia" had fixed conductors in masts.

147. PRESTON 74. Sheer Hulk, Woolwich, 24th June, 1804.—Cap of sheers set on fire, with hood of mast; sheers damaged; vessel and yard in danger of being burned. Lightning conductors ordered to be applied.

148. PRIMROSE 18. 5th Nov., 1828.—Sierra Leone, 7h. 30m. A. M., main-topgallant-mast shivered; other damage.

149. PRIMROSE 18. 25th March, 1829.—Cape Mesurado, 3h. A. M., main-topmast and topgallant-mast shivered; mainmast shook; mizen-topmast disabled. Fished the mainmast.

150. PRINCE WILLIAM, Sheer Hulk, at Portsmouth.—(In the same storm with "Elephant" 74) 24th Nov., 1790. Sheers shivered.

151. QUEEN 98. 15th March, 1815.—Messina Harbor, 1h. 45m. P. M., main-topgallant and topmast destroyed; mainmast disabled and removed.

152. RACEHORSE 18. 17th Oct., 1831.—At sea, off Port Royal, 4h. 30m. A. M., main-topgallant-mast and topmast shivered; mainmast damaged; after pumps split open; all the bulk-heads near the mast smashed.

153. RACEHORSE 18. 12th Jan., 1840.—Coast of Brazil, 2h. 40m. P. M., fore-topgallant-mast shivered; a beam split; bitts damaged; three men hurt.

154. RACER 16. 30th Oct., 1834.—Off Carthagena, 2h. A. M., twice struck; both topmasts carried away in the caps; topsail-yard damaged.

155. RACER 16. 26th May, 1840.—Fore-topgallant-mast shivered; ship had a chain conductor on mainmast.

156. REDPOLE 10. 18th Oct., 1822.—Corfu, 4h. A. M., main-topgallant-mast shivered.

157. REDWING 18. 12th Aug. 1819.—Algoa Bay, 9h. 10m. P. M., fore-topmast and topgallant-masts destroyed, together with two studding-sail-booms, cap, and cross-trees; deck covered with splinters and chips; topgallant-sail and yard destroyed.

158. RENARD 6. 4th Nov., 1834.—St. Thomas's, 7h. 45m. P.M., fore-royal and topgallant-mast and topmast shivered; other damage.

159. RENOWN 74. 8th Sept. 1801.—Off Toulon, 11h. P. M., mizen-mast shook, and topgallant and topmast splintered. Mast subsequently taken out.

160. REPULSE 74. 13th April, 1810.—Coast off Catalonia, 12h. 35m. P. M., ship struck twice; main-topgallant and topmast shivered;

mast disabled; seven men killed, nine hurt; two died after. See No. IV.

161. Resistance 44. 25th June, 1811.—Off Gorgona, 6h. A. M., mainmast damaged and set on fire; main-topmast and topgallant-mast destroyed. Threw overboard topgallant and topmast studding-sails to clear the fire. Two ships in company disabled at the same time, "Unite" 36, and "Ajax" 74.

162. Resistance 44. 16th Nov., 1794.—Balambangan, 5h. 15m. A. M., main-topgallant and topmast shivered in pieces; mainmast much damaged.

163. Revolutionnaire 44. 31st March, 1815.—Moira Roads, 3h. P. M., mainmast shattered; topmast and topgallant-mast destroyed. Had a new mast at Manilla.

164. Rhadamanthus 4, Steamer. 13th March, 1837.—At Santander, 3h. A. M., main-topmast shivered.

165. Rodney 90. 7th Dec., 1838.—Off Syracuse, 9h. A. M., main-topgallant-mast shivered into chips; main-topmast damaged; cap split open; gear on the yard set on fire; mainmast ruined; two men killed, two wounded. Ship sent into Malta for refit and a new mast.

166. Roebuck, Cutter, at Motherbank, Isle of Wight. 10th Dec., 1825.—Mast shook and damaged.

167. Royalist 10. 13th Aug., 1851.—Labuan, at anchor; fore-topmast and topgallant-mast shivered; four men struck down.

168. Royal Oak 74. Provision Ship, Bermuda. Feb., 1829.—Mainmast set on fire; burned rapidly; extinguished by crew of the "Hussar" and others.

169. Royal Sovereign 110. 9th Nov., 1809.—Off Barcelona, 5h. P. M., main-topgallant-mast splintered; two men killed; all on main deck knocked down.

170. Royal Sovereign 110. 29th Nov., 1813, Plymouth.—Foremast shattered by lightning; had a new mast.

171. Ruby 64. 21st July, 1810.—Baltic, 11h. 30m. P. M., mainmast crippled, topmast and topgallant-mast destroyed.

172. Russell 74. 1st Oct., 1795.—Off Belle Isle, 1h. 30m. P. M., mainmast disabled, also mizenmast; topmasts both shivered, also main-topgallant-mast. First lieutenant and two seamen killed, many badly hurt. Ship in danger of being lost on the French coast.

173. Russell 74. 2d Feb., 1836.—Ferrol, at anchor, mainmast damaged, and found to be unserviceable; replaced at Plymouth.

174. Sabrina 18. In 1811.—Mainmast ruined by lightning, and removed at Plymouth Yard.

175. Saint Lawrence 104. 19th Oct., 1804.—Lake Ontario, 5h. P. M., mainmast shook; topmast shivered; five men wounded.

176. Salamine 16. Nov., 1799.—Off Leghorn, 11h. P. M., foremast struck, main-topmast stay-sail set on fire; lightning exploded some musket-ball cartridges below decks.

177. Salvador del Mundo 112. 25th Feb., 1812.—At Plymouth, 11h. A. M., one man killed; slight damage.

178. Sampson 74. Sheer Hulk at Woolwich. 5th July, 1822.

—Mast and sheers damaged. Navy Board, in 1804, ordered conductors. See 147. Order appears to have been of little use.

179. San Josef 112. 11th Dec., 1803.—English Channel, 12h. 30m. A. M., mainmast damaged, and found to have been ruined; struck obliquely, just under the top; all the watch on deck benumbed.

180. San Josef 112. 25th Sept., 1813.—Off the Rhone, at anchor; main-topmast and topgallant-mast shivered and rent.

181. Sappho 18. 9th Feb., 1820.—At sea, off the Western Islands, 8h. 20m. P. M., foremast, topmast, and topgallant-mast shivered; two men killed, four more lost overboard, fourteen wounded, four died soon after.

182. Scorpion 10. 27th Feb., 1838.—Off Sardinia, 8h. 5m. A. M., mainmast shivered, also main-topmast; main-deck beam damaged; two men severely hurt.

183. Scorpion 18. 20th Sept., 1806.—Off Fayal, 10h. 40m. A. M., mainmast shivered; one man killed, one wounded.

184. Scylla 18. 20th July, 1835.—West Indies, 2h. 30m. A. M., fore and main-topgallant-masts shivered; much other damage.

185. Sea-Horse 36. 31st July, 1780.—Straits of Malacca, 5h. 30m. A. M., main-topgallant-mast and mainmast, sails, and rigging severely damaged; one man knocked overboard; had charge of convoy.

186. Sheldrake 16. 23d June, 1811.—At anchor, Great Belt, 8h. 30m. P. M., mainmast-top and topgallant-mast split into ribbons; boom damaged.

187. Sir Francis Drake 36. 8th Dec., 1806.—Off Java, 1h. 30m. P. M., main-topmast and top-gallant-mast shivered in pieces; other damage.

188. Snake 16. 25th June, 1838.—West Indies, 9h. 20m. A. M.; mainmast severely damaged; topmast and topgallant-mast shivered.

189. Southampton 52. 5th Nov., 1832.—In the Downs; 12h. 30m., mizenmast ruined; mat on topsail-yard set on fire; several of the ship's beams shook; two men severely hurt; other damage in the hull.

190. Spartiate 74. 1827.—In the Tagus; slight case; conductor on mainmast: struck near the deck, abaft the foremast. Twice struck.

191. Squirrel 28. 26th Dec., 1791.—Beerhaven; 7h. P. M., mainmast damaged, and burned on one side; many men struck down.

192. Squirrel 28. 18th Nov., 1804.—Bengal; 9h. 15m. A. M., mainmast, topmast, and topgallant-mast shivered and rendered unserviceable.

193. Squirrel 28. 23d Feb., 1805.—Cape Coast; 7h. 10m. A. M., mainmast rendered useless; topmast and topgallant-mast shivered; two men badly hurt; a plank in the side stove; all the caulking loosened from the fore to main chains. Ship made 8 inches of water an hour.

194. Stanmer 10, West India Packet. 15th Sept., 1838. Off Cuba; 5h. 30m. P. M., mainmast damaged, topmast and topgallant-mast shattered.

195. STARLING 6, Schooner. 8th Nov., 1840.—China Seas; 1h. 30m. A. M., foremast shivered in atoms; topmast burned to a cinder, yards and sails all went by the board; one man severely injured.

196. STAUNCH 16. 10th March, 1807.—Rio de la Plata; 6h. 40m. A. M., fore-topgallant and topmast rent in pieces; fore-topsail set on fire; foremast much damaged. Went to Monte Video for refit.

197. SUCCESS 36. Dec., 1800.—Off Malta; 8h. A. M., mainmast disabled and set on fire; topgallant-mast and topmast shivered throughout.

198. SULTAN 74. 12th Aug., 1808.—Off Mahon; 12h. 30m. A. M., jibboom shivered; seven men killed on it, three wounded whilst furling jib.

199. SULTAN 74. 19th Sept., 1812.—Off Tavolera; 4h. P. M., mainmast, topmast, and topgallant-mast split in pieces; topgallant-yard and sail destroyed; mats on the yard set on fire; topmast fell over the side; heart of mainmast torn out. Went to Malta.

200. SUPERB 74. 19th Sept., 1802.—Gibraltar Bay; 9h. A. M., main-topgallant-mast shivered; same storm with "Active" and "Gibraltar," which see.

201. SURINAM 18. 11th Dec., 1806.—Off Belle Isle; 11h. 30m. P. M., mainmast split in pieces, which stove in the decks; pumps split; two men killed, four badly hurt; ship nearly lost on the Coast of France. See No. IV.

202. SWIFTSURE 74. 10th Feb., 1801.—Marmorice Bay; 1h. P. M., mizen-topmast shivered in atoms.

203. SWIFTSURE 74. 22d Jan., 1807.—Palermo; 8h. 10m. P. M., fore-topmast rent open and set on fire, together with the topsail, which burned vividly; ship in great jeopardy.

204. SWIFTSURE 74. 2d September, 1813.—Off the Rhone, at anchor; main-topmast shivered in pieces.

205. SYBILLE 38. 28th Jan., 1796.—Off the Cape; 1h. A. M., two men killed, one in maintop; ship had a chain conductor on mainmast when struck; mast not much damaged.

206. TAMAR 26. 11th July, 1822.—Off Jamaica; 5h. 15m. A. M., mainmast badly damaged; topmast carried away; rigging and sails torn in pieces; main-topsail set on fire and burned.

207. TAMAR 26. 1st June, 1835.—River Hooghly; A. M., mainmast shivered in pieces; topgallant and topmasts destroyed.

208. TEES 26. 5th June, 1820.—Off the Cape; 4h. 40m. A. M., foremast ruined; ship struck whilst lowering top-gallant-mast; two men killed, four wounded.

209. TERRIBLE 74. 23d April, 1799.—Spithead; 5h. 30m. A. M., foremast and topmast shivered; two carlines over the fore magazine rent in pieces.

210. THESEUS 74. 19th Oct., 1803.—Off St. Domingo, 8h. 30m. A. M., fore-topgallant-mast shivered; topmast and foremast splintered and shook in pieces; one man killed; decks covered with chips; great panic; ship obliged to leave her station for refit.

211. THETIS 46. 8th April, 1828.—Rio de Janeiro; A. M.,

moderate and cloudy; P. M., heavy rain, with thunder and vivid lightning; 6h., the fore-topmast and foremast were shivered by the lightning; the larboard cheek of the mast fell on deck, and part of the topmast went over the side; A. M., employed unrigging mast; 10th, A. M., moderate; 8h. received two spars for sheers from the Brazilian dockyard, &c.; P. M., got out foremast, and towed it ashore to the dockyard; 12h. rainy, &c.

Of the five ships composing the Brazilian squadron for the protection of our trade during the war with Brazil and Buenos Ayres, this frigate and the "Heron" corvette were both disabled by lightning, so that convoys could not be granted for some time, it having been found difficult to get new masts, and then only at a great cost. See "Heron."

212. THISBE 32. 4th Jan., 1786.—Off Scilly, lat. 50° 39′ N., long. 7° W.; P. M., midnight, bore up for Cork, in want of provisions; blowing hard; A. M., strong gales; P. M., handed mainsail and main-topsail; hove to under storm-staysails; 4h. 15., a flash of lightning, attended with a tremendous clap of thunder, disabled some of our people. A few minutes after, a second flash set the mainsail, top, and mizen-staysails on fire, which spread so fast, we were obliged, for our own safety, to cut away the mainmast; this carried away mizen-topmast and fore-topsail yard. In securing the fore-topsail yard, found the foremast much shivered by the lightning. At 5h., clear of the wreck and all secure, except the fore-topmast, which went over the side about 9h., together with the foremast head. Set the foresail and bore away. Saved the topsail; cut the cutter up, which was stove by the mainmast going over the side. At noon, fresh breezes and clear.

One of the officers of the ship, the late Mr. Moore, Purser R. N., states in his journal, that—"The lightning struck the main yard; swept over the decks; the men near the guns were all knocked down. The sail at the mainyard now burst out into a flame, which quickly passed along the rigging to the other masts, and the whole was in one general blaze. In this dilemma, the master cut the lanyards of the weather rigging, when the whole went over the side. He then wore the ship so as to avoid further injury from the wreck of the mast."

This frigate was left a mere wreck on the sea; they rigged jury-masts and went to Portsmouth.

213. THUNDERER 74. 12th Aug., 1797.—Off Cape Corrientes, E. by N. 8 leagues; P. M., squally; 8h. 15m., a flash of lightning struck on mizenmast, and passing down the mast, blew up twenty-eight powder-horns hanging round it on the lower deck, by which means several cots took fire, and seven men and a boy were wounded; got an immediate supply of water, and extinguished the fire.

214. THUNDERER 74. 8th Sept., 1799.—Lat. 18° N., long. 79° W.; 10h., 30m. P. M., main-topgallant and topmast ruined; mainmast splintered; one man lost overboard, several badly hurt; all the watch in the maintop paralyzed; obliged to lower them down by ropes.

215. TIGRE 80. 9th Nov., 1809.—Off Toulon; mainmast disabled, and other damage. Mast shifted.

216. Tonnant 80. 25th Feb., 1812.—Cawsand Bay, 11h. 50m. A. M., foremast, mainmast, and main-topmast shivered and ruined; had both masts out; one of Channel Fleet.

217. Tonnant 80. 5th Dec., 1804.—Off Belle Isle, 11h. A. M. Ship twice struck; one man killed, ten men hurt severely; mainmast disabled; shifted in February following.

218. Topaze 36. 23d July, 1802.—Off St. Domingo, 2h. 30m. A. M., mizenmast, topmast, and topgallant-mast shivered and ruined; two men killed near the mast, many wounded; two horns blown up in captain's cabin. Mast taken out at Port Royal.

219. Trident 64. 27th Oct., 1803.—Coast of Malabar, 1h. 30m. A. M., mast disabled; topmast and topgallant-mast knocked overboard; four men badly hurt. Taken in tow for two days by the "Tremendous" 74.

220. Trincomalee 20. 23d June, 1802.—At Trincomalee, 4h. 30m. P. M., foremast, top, and topgallant-mast shivered and ruined; had a new mast.

221. Triumph 74. 6th Dec., 1803.—Off Sardinia, 8h. P. M. Two men killed; many wounded; spars damaged; mat on mainyard set on fire.

222. Trusty 50. 16th Oct., 1801.—Malta, 4h. 40m. P. M., mizenmast damaged; topmast and topgallant-mast shattered in pieces.

223. Tyne 28. 17th Dec., 1839.—Dardanelles, 9h. 20m. A. M., main-topgallant and topmasts shivered; mainmast damaged.

224. Union 98. 2d Sept., 1813.—Off Toulon; lost main-topmast.

225. Unite 36. 25th June, 1811.—Off Elba, 6h. 25m. A. M., fore and mainmast ruined and shook; main-topmast shivered in pieces and knocked overboard; fore-topmast and topgallant-mast sprung in many places; fore-topsail set on fire; many men badly hurt, one lost overboard. This ship was one of the Mediterranean fleet, of which two others, "Ajax" and "Resistance" were disabled in the same storm.

226. Valiant 74. 5th April, 1813.—Off Boston, 8h. 20m. P. M., main-topgallant-mast and main-topmast destroyed; topsail-yards and sail split and rent; mizen-topgallant-mast shivered and carried away.

227. Ville de Paris 120. 22d Oct., 1811.—Off Toulon, 3h. 15m. A. M., main-topmast and topgallant-mast shivered in atoms; mainmast rendered unserviceable; much other damage. Ship went to Mahon.

228. Victor 28. 28th May, 1803.—East Indies, 10h. 30m. A. M., main-topgallant-mast and topmast, together with lower-mast, shivered and ruined; lower rigging damaged. Had a new mast.

229. La Virginie 38. 28th Sept., 1799.—Madras Roads, 10h. 45m. P. M., main-topgallant and topmast shattered in pieces; main-mast disabled; main-topsail-yard destroyed; all the rigging scorched.

230. Wasp 18. 10th Jan., 1814.—Gulf of Florida, 4h. 45m. A. M., mainmast and topgallant-mast damaged. 11h. 30m. again struck, main-topmast shivered in pieces and knocked over the side; two men killed.

231. Wasp 18. 25th Feb., 1838.—Mediterranean; nine men struck down, two very badly hurt.

232. Windsor Castle 98. 28th Sept., 1794.—Leghorn Roads, 8h. 30m. A. M., foremast and foreyard struck and set on fire; two men much hurt.

233. York 74. 25th Sept., 1800.—Port Royal, 1h. P. M., main-topmast and topgallant-mast shivered; mainmast seriously damaged; four men killed and six wounded; struck whilst furling main-topsail.

234. Zealous 74. 26th Dec., 1796.—Tagus, at anchor; main-mast struck; one man killed.

235. Zebra 18. 27th March, 1838.—Straits of Malacca, 9h. 20m. P. M., main-topgallant and topmast shivered; fell on the deck; main-cap split; the jib and sails on mainmast scorched.

Some General Deductions from the Foregoing Cases.

The liability of lightning to strike on any given point appears to be as follows:—

In 2 out of 3 times it strikes upon the topgallant-mast or highest point.
1 in 5 " " topmast or next highest point.
1 in 7 " " lower mast or next highest point.
1 in 50 " " hull directly.

From this it may be inferred that the electrical discharge is occasionally determined towards ships in directions more or less oblique to the masts and hull.

The liability of lightning to fall on one or more of the masts simultaneously, is as follows:—

In 2 out of 3 instances, a ship is struck by lightning on the mainmast.
1 in 5 times " " foremast.
1 in 20 times " " miz'mast.
1 in 200 times " " jibboom.

1 in 6 instances the yards and sails are struck together with the masts.

A ship may be struck by lightning on the fore and mainmasts about the same time, or on the main and mizenmasts at the same time, or even on all three masts simultaneously, but in no case on the fore and mizenmasts simultaneously, independent of the mainmast.

In such cases lightning has fallen on the fore and mainmasts together, in about once in 20 times; on the main and mizenmasts together, once in 40 times; on all the masts, once in about 200 times.

The liability of lightning to strike upon a ship in a single or divided stream, and in directions more or less oblique, appears to be as follows:

In 1 out of 16 instances, the electrical discharge falls on a ship in a forked or divided stream of two or three branches.

In 1 in 20 times, it falls obliquely in respect of the masts and hull in a single branch.

In about once in 27 times, ships are struck by quickly-repeated discharges in the same storm, from 2 to 5 times.

We find in these instances, 4 cases in which ships, having a common chain conductor at the main, have been struck by lightning on the foremast, and about 6 instances in which from some cause the common chain or wire conductor failed to afford the required protection.

No. II.

Expenditure on Account of Damage to the Royal Navy by Lightning.

We can scarcely hope to determine with very great accuracy, and in its full extent, the absolute loss to the public Exchequer on account of damage to the Royal Navy by lightning: independently of the calculation being very intricate and complicated, the total number of instances in which H. M. ships have suffered from lightning is not known, or can they now be traced. Of this, however, we may be quite assured; the amount must have been, since the war in 1793, something very considerable.

The mainmast of a 74 gun ship, made of Riga spars, was in the last war estimated at £1000 and upward. The mainmast of a first rate, £1200. We find a 74's mainmast estimated at £850 nearly in the subsequent peace. A 44 gun frigate's mainmast cost £476 in the war, and above £400 in the subsequent peace. Topmasts of ships of the line varied from £140 to £180; of frigates, from £80 to £100. The contract price for spars for topmasts was once £200 each: seeing therefore the large quantity of made masts and other spars destroyed in the 235 instances recorded in No. I., the loss upon this item could not have been insignificant. Then again we have to consider not only the mere spar, but the appendages of cross-trees, trussel-trees, &c. &c.; also the large quantity of rigging and sails destroyed, or what is called expended. We have likewise to consider the cost of transporting masts and spars to foreign stations, all tending to swell the amount very considerably. After all this has been duly entered upon, we shall not then have come near the amount of the expenditure really involved; the mere material is at last but a small item. We have further to take into account the pay and provisions, and general expenses of a ship, in cases in which she is rendered useless until repaired. Take

such a case, for example, as that of the "Thisbe," before given, (212, No. I.) or the "Lowestoffe," (109.) In such cases the vessels are for a time temporarily wrecked, and if the service on which they are employed be of critical importance, they must be replaced by other ships.

Now the cost of a ship of the line is from £80 to £110 per day; of a frigate, from £30 to £50 per day; brigs and sloops, from £10 to £20 per day. Whenever, therefore, a ship of the Navy is placed for a given time "*hors de combat*" by lightning, the country has to provide for the expense of a ship not available for the public service, and that is really a serious loss to the Exchequer. Now we see by cases quoted in No. I., that within five or six years we had no less than 40 ships of the line, 20 frigates, and 10 sloops struck and damaged by lightning; in all, 70 ships, being about the one-eighth part of the Navy then in commission; these were nearly all obliged to go into port for refit. When this is duly considered, the real cost to the Crown in consequence of ships of the Navy damaged by lightning is almost incalculable.

We may by a great generalization upon the 235 cases determined in No. I., arrive at something like an estimate of the amount of money directly lost on those cases, by taking twice the mean value of any mast or spar replaced as a representation of the outlay for that particular spar, taking one case with another; referring, for example, to the estimated values of made masts and spars of different classes of ships, we find the mean value of the lower mast of a ship of the line in war, about £850, in peace, about £550; that is, taking the mean value of masts made of Riga sticks, and of yellow pine only. And so on for other spars replaced. Now if we double these mean values we shall not be far from the average expenditure upon all these cases, taking into the account every contingency, viz., destruction of sails, rigging, &c., one case with another. Take, for example, the case of the "Rodney" 90, (167, No. I.) in which the ship lost mainmast, &c. &c., with other damage. Now we may here consider the final expense to the Crown, including everything, as being represented by twice the value of the replaced spars. That is to say, it would be about £2000, independent of the cost per day of the ship; and this will be found a very moderate estimate, as those accustomed to deal with such matters will admit. For it is to be remembered that when any ship strips her masts and they are taken out, there is always a large expenditure of rigging, beside the actual destruction by lightning.

Taking one case with another, therefore, and confining ourselves to the cases in which the vessel's masts were replaced, and dividing the cases in No. I. into two periods, viz., 23 years' war, 1793 to 1815, and 23 years' peace, viz., 1815 to about 1839, the loss to the Exchequer upon these cases, taken in terms of the mean value of the spars expended in each of these periods, would be for the period of war about £140,000, for the period of peace, about £28,000. The loss in the peace would be necessarily very much less, because of the reduced numbers and size of the ships. This, however, would give

about £6000 a year in war, and something more than £1200 a year in the peace, upon these cases only, without at all considering the pay and provisions of the ships under refit.

It will be found by an analysis of No. I., that of these cases, for the most part within 23 years' war, there were struck and damaged by lightning on service 76 ships of the line, 56 frigates, 30 sloops. In the subsequent peace of 23 years, we may consider as being struck and damaged on service 8 ships of the line, 15 frigates, and about 50 sloops and other vessels—that is, so far as ascertained.

Although massive calculations on a great generalization of this kind may be open to some exception, yet they still furnish useful approximations. It cannot be denied but that the loss to the public Exchequer in consequence of casualties by lightning in the Royal Navy has been of a serious amount, and must have certainly exceeded in cost of material £140,000 upon 164 cases in the war, and £28,000 upon 71 cases in the peace, being a portion only of the whole number of casualties. The loss of ships in all probability totally destroyed by lightning has been in this calculation discarded, but this probability must still not be lost sight of in any estimate of the cost to the country of damage to the Royal Navy by lightning. See No. VII.

If we add to this the pay and provisions of crippled ships, and reflect, as observed by the late and intelligent Captain Basil Hall, R. N., in writing on this subject, that the fate of a battle, a colony, or a great expedition, may depend on the efficient services of a single ship, then the cost to the country of damage to its Navy by lightning is quite incalculable. See cases of "Guerriere," No. 83, "Glory," No. 78, and others quoted No. IV.

No. III.

Instances of Loss of Life or Injury to the Seamen in certain cases of Ships of the Royal Navy damaged by Lightning.

[The numbers refer to No. I.]

No. of Case.		Guns.	
3	Active - -	36	Two men killed.
4	Africaine -	36	One man killed.
6	Agamemnon	74	Four men dangerously hurt.
13	Arab - - -	22	Three men killed; six badly hurt.
23	Bellette - -	20	Thirty-six men struck down hauling the head braces; five badly hurt.
24	Bellerophon -	74	One killed; eight wounded.

No. of Case.		Guns.	
25	Bittern	16	Eight men struck down and sent to the hospital.
26	Bloodhound	16	All the watch on deck struck down.
36	Cambrian	44	Two killed, twenty taken below badly hurt; all the men on one side of the deck knocked down.
37	Captain	74	Four killed; twenty-four struck down.
42	Clorinde	44	Three killed; five wounded.
53	Dispatch	18	Twenty men injured.
59	Eagle	74	Ten men injured severely, one wounded in a former case.
61	Edgar	74	Many men severely hurt.
64	Elk	10	Four men badly hurt; two lost the use of their limbs.
67	Foudroyant	74	One killed; many severely hurt.
81	Goliah	74	Two men killed; thirteen much injured.
101	Kent	74	One killed, two wounded, several hurt.
102	Larne	20	Two men killed; many injured.
109	Lowestoffe	36	Two killed, three knocked off mast-head; lightning swept the decks and disabled many of the crew.
117	Mignonne	18	Five killed; one badly hurt.
119	Minerva	36	One killed; two wounded.
124	Narcissus	36	Several men blinded at the halliards.
132	Palma	44	One killed; six severely hurt.
137	Perseverance	36	Two dangerously hurt; many wounded.
140	Phœnix	36	One killed; several injured.
143	Pomone	44	One killed; four wounded.
144	Pomone	44	All before mainmast struck down; many severely hurt.
145	Pompée	74	One killed; one wounded.
153	Racehorse	18	Three men injured.
160	Repulse	74	Eight killed, twelve severely injured; two of these died after.
167	Rodney	90	Two killed; two badly hurt.
168	Roy. Sovergn	110	Two killed; all on main deck knocked down.
172	Russel	74	First Lieutenant and two men killed; many hurt.
175	St. Lawrence		Five men wounded.
177	S. del Mundo	112	One man killed.
178	San Josef	110	All the watch on deck benumbed.
181	Sappho	18	Four men disappeared off foreyard, two killed on deck, fourteen severely wounded; four of these died soon after.
183	Scorpion	18	One killed, one wounded; two severely hurt in a former instance.
189	Southampton	52	Two men dangerously hurt.

No. of Case.		Guns.	
198	Sultan - -	74	Seven seamen killed; three severely wounded whilst furling jib.
201	Surinam - -	18	Two killed; four badly hurt.
205	Sybille - -	38	One man killed in maintop.
208	Tees - - -	26	Two killed; four wounded whilst striking topgallant-masts.
210	Theseus - -	74	One man killed.
212	Thisbe - -	36	All near the guns knocked down; many badly hurt.
213	Thunderer -	74	Seven men and a boy dangerously wounded; electrical discharge blew up twenty-eight powder-horns round mizenmast.
214	Thunderer -	74	One man lost overboard; many hurt. The watch in maintop paralyzed and lowered down by ropes.
216	Tonnant - -	80	One man killed; ten men dangerously hurt.
218	Topaze - -	36	Two men killed; the chaplain and many of the crew seriously hurt.
219	Trident - -	74	Four men badly hurt.
221	Triumph - -	74	Two killed; many badly hurt.
225	Unité - - -	36	One man lost overboard; many badly hurt.
230	Wasp - - -	18	Two seamen killed.
231	Wasp - - -	18	Nine men struck down; two badly hurt.
232	Wind. Castle	98	Two men badly hurt.
233	York - - -	74	Four killed, five badly wounded whilst furling main-topsail; many hurt on lower deck.
235	Zealous - -	74	One man killed in foretop.

[The above are the most remarkable instances in No. I.]

No. IV.

Instances of the Crippled State of Ships by Lightning at critical periods.

The instances in which ships have been crippled by lightning at critical times, found in No. I., are very striking and remarkable. We have first to notice the "Duke" 98, No. 57, disabled by lightning whilst engaged with the batteries in the attack on Martinique, in June, 1793. This ship was one of Admiral Gardner's squadron, consisting of the "Queen" 98, "Duke" 98, "Hector" and "Monarch"

74s, "Ephigenia" and "Ulysses" frigates, and a division of transports. The "Duke" was being engaged with the batteries, which defended the town of St. Pierre, and sounding for anchorage, when lightning most completely disabled the ship, shivered her mainmast from the truck to the deck, and placed the vessel quite *hors de combat*.

In the cases of the "Ajax" 74, No. 7; "Resistance" 44, No. 161; and "Unité" 36, No. 225, we have an instance of a ship of the line and two frigates on an important service and station, all disabled by lightning at the same instant. Two french 40-gun frigates and a store-ship, with shells and gunpowder, had escaped out of Toulon. Admiral Sir Charles Cotton had detached the "Ajax" and "Unité" in pursuit; these ships were finally joined by the "Resistance," and were, at the time of being disabled, off Elba, in hourly expectation of falling in with and intercepting a French squadron of frigates.

Cases of "Alexander" 74, No. 9; "Dragon" 74, No. 55; and "Renown" 74, furnish an instance of one-half of a squadron crippled by lightning, all about the same time. The ships formed part of the Mediterranean fleet under Sir J. B. Warren, engaged in active operations off Leghorn. The fleet consisted of the above ships, together with "Gibraltar" 80, Genereux" 80, and "Stately" 64; of these, the "Renown" lost her mizen-topmast and topgallant-mast, and suffered also in the mizenmast; the "Dragon" 74 had her mainmast sprung, topmast and topgallant-mast shivered in pieces, and main-topsail rent; the "Alexander" lost main-topmast, shivered in pieces.

The cases of "Ocean" 98, No. 128; "Swiftsure" 74, No. 204; and "Union" 98, No. 224, constituted one-half the inshore squadron of our fleet, on the blockade of Toulon, amounting to 13 sail of the line; of these, the three ships above named, together with the "San Josef" 120, No. 180; "Barfleur" 74, No. 22; and "Hibernia" 120, No. 93, that is, nearly half the fleet, were all severely damaged by lightning within about ten weeks. Only a few months after this the fleet, augmented in numbers, was engaged in a critical affair with an enemy's squadron making for Toulon; indeed so frequent and destructive had been the effects of lightning on this station, that it was quite a terror to the seamen; so much so, that the Admiral, Sir Ed. Pellew, promulgated an order not to send the men aloft during the prevalence of lightning.

The "Glory" 98, No. 78, furnishes an instance in which a ship of the line was disabled by lightning only a short time previously to a general action; an account of this remarkable case has been already given, No. 78. See Case, No. I.

The "Guerriere," No. 83, is an instance of a frigate, fighting a superior force with her mainmast in a defective state, from a stroke of lightning, and which might have stood but for this defect; the weak state of the "Guerriere's" mainmast by lightning has been referred to by the celebrated naval historian, Mr. James, and was admitted in the evidence on the subsequent Court-Martial; the mainmast was carried away in the action by the fall of the foremast across the mainstay, which certainly might not have led to this disaster had the mainmast

been in an efficient state; the loss of all the masts was the loss, probably, of the ship; we see by No. 83, No. I., how this mast had suffered by lightning; the total amount of damage it had received had never been well ascertained; a mast may be ruined by lightning to the heart, and yet exhibit but small traces of damage externally, as is seen in many cases.

The "Repulse" 74, No. 160, is an instance of the finest ship of a squadron detached on an important service placed in an instant *hors de combat.*

The following is an interesting notice of this dreadful case by Commodore Richards, R. N., then a lieutenant in the ship:—

"On the 6th April, 1813, the 'Repulse,' of 74 guns, Captain John Halliday, one of the fleet under the orders of Rear-Admiral Sir Samuel Hood, having had a careful refit at Minorca, sailed from thence with a view of preventing supplies being thrown into Barcelona, and of intercepting the French fleet from Toulon. On the 8th, the fleet reached its cruising ground westward of Cape St. Sebastian, and on the 13th encountered one of those severe thunder-storms so common in the Mediterranean. The 'Repulse' was twice struck by lightning; the first shock was slight, and caused but little damage, but the second stroke shivered the main-topgallant-mast and topmast, entered the mainmast-head above the rigging, and passed out in several places between the lower part of the side fishes and the decks; it descended below and filled the ship with a strong sulphurous smell. The rain fell in torrents; the topgallant-mast and topmast were ruined, and totally unserviceable, and the mainmast so much injured, that even after the application of fishes, only a moderate quantity of sail could be carried on it.

"The damage to the ship was sadly aggravated by the dreadful loss of life which attended the accident. *Seven men were killed on the spot, three others only survived a few days, making a loss of ten lives. Ten others were so crippled and hurt, as to be of little use to the service after.* This melancholy occurrence involved as great a loss of life and material as would probably have resulted from a successful fight, perhaps greater. The ship was as much crippled as if she had been in a general action, with a loss of *twenty of her crew, placed hors de combat.*

"Had the fleet been called upon to chase, the services of one of its fastest ships must have been entirely lost to it. The mast was so bad as to cause the ship to return to Minorca, on the 3d of May, for repairs. The crippled state of the mast still remained, however, a source of anxiety to every one until it was finally removed, which it would have been immediately after the accident, had the *limited resources of Minorca furnished the means of replacing it,* or *had the reduced state of the fleet, then inferior in numbers to the enemy, allowed the Admiral to send the ship to the more distant ports of Malta or Gibraltar.*"

The "Trident" 64, No. 219, is a somewhat similar case. This

ship was one of Admiral Rainier's fleet, opposed to Linois, in the East Indies, at the breaking up of the short peace, in 1803.

A great many instances of this kind are amongst the cases in No. I. The "Endymion," No. 66, is an instance of a fine frigate disabled in her foremast when about to proceed to join and strengthen our fleet in China, in our last naval war there.

The cases of the "Heron," No. 92, and "Thetis," No. 211, are remarkable instances of the temporary loss of the services of two ships out of five of a squadron sent to South America in 1828, for the protection of our trade during the war between the Brazils and Buenos Ayres, so that convoys for our merchant ships could not for some time be provided.

The case of the "Norge," No. 127; the "Dictator" 64, No. 52; "Hind" 20, No. 94; "Isis" 36, No. 99; "Sea Horse" 36, No. 185; "Hydra" 36, No. 97, are all severe examples of ships being disabled by lightning with convoys of merchant ships dependent on them. The "Tamar" 26, No. 206, is again a most critical case of this kind. These ships were nearly all so crippled, that they could have done but little at the time in defending the fleets under their protection against an enemy.

It may not be unimportant to refer in addition to these cases to the extreme peril in which H. M. ships have been occasionally placed. The annexed engraving,* for example, represents the actual position of the "Surinam," one of the look-out brig sloops attached to the squadron of Rear Admiral Louis, despatched in the 80-gun ship "Canopus," from the channel to cruise to the westward of Belle Isle, for the purpose of intercepting on their return from the West Indies, M. Willaumez and the French fleet, which had escaped out of Brest; the services of a sloop of this kind were here very important. This ship's log is quite frightful; it runs as follows:—

11th Dec., 1806.—Ile de Grois E. by N. 4 leagues; P. M., thunder, lightning, and rain; 11h. 30m., a furious squall; mainmast shivered in pieces by the lightning, part of it fell in the hold, where it lodged, part on the booms. The lightning split both pumps, killed two seamen, and wounded four, and did very considerable damage in many parts of the ship; deck stove in by the falling of the mast; cabins below destroyed by the lightning, which struck down into the magazine passage.

12 A. M.—Threw up rockets with blue lights and false fires, signal guns; but the gale was so high with heavy rain and sea, could not discover whether they were answered. Ship labored much; employed clearing wreck and getting small sails aft to keep the ship's head to the wind and sea, and *prevent her drifting on the shore;* hove several casks, stores, and sails overboard from the wreck; 11h. 45m., anchored. The weather moderated, and they saved the ship, which had well-nigh been wrecked on the French coast.

The log of the "Thisbe" frigate, (No. I., 212) presents another

* Engraving omitted, being expensive.

frightful case of this kind; decks swept by lightning, people struck down in all directions, the sails and gear aloft in one great blaze, and the ship left a perfect wreck.

The log of the "Lowestoffe," a sister ship to the "Thisbe," is again a most striking instance of the terrible devastation of lightning in ships; it runs thus:—

"Remarks on board H. M. ship 'Lowestoffe,' Tuesday, 8th March, 1796. North end of Minorca, 5° 6′ W., distance 134 miles, wind S. E. to E.

"P. M.—Heavy squalls of wind, attended with much thunder, lightning, hail, and rain; 12h. 15m., a flash of lightning striking three men, knocked them from the mast-head, one of whom, viz., John Goolan, was struck dead, leaving the others much burned and benumbed. 12h. 30m., another flash struck many on the different decks, rendering them motionless, and in its course shivered main-topmast in pieces; *a few minutes after another flash set the ship on fire, in various parts of the masts and rigging;* it was eventually smothered by torrents of rain and hail. The lightning broke several hoops of mainmast and shivered it in pieces, also split the fore-topmast in pieces, and carried away the fore-topsail yard; it knocked many men at the same time out of the tops, one of whom, viz., James Campbell, was killed on the spot; the lightning entering between decks, made such an explosion as to affect all, rendering some totally benumbed in different parts of their bodies.

"1h. 30m.—The mainmast being found so shook, we were obliged to cut it away, in order to save the other masts and prevent its falling in a dangerous direction. Employed clearing wreck; 2h. 30m., weather began to clear, set the foresail, &c.

"11th March.—Anchored in Port Mahon; the ship was detained under refit until the 10th of May following, when she sailed out of the Bay, and very soon after fell in with a French frigate, and fought a severe action; now this might have happened immediately after being disabled by lightning, in which case the ship must have been taken. She was one of the look-out frigates attached to Admiral Hotham's fleet in the Mediterranean, afterward under Sir John Jervis."

Such are the many important examples of the great inconvenience to the public service, and to the best interests of the country, arising out of the destructive effects of lightning in the Royal Navy.

No. V.

List of Ships of the Royal Navy struck and damaged by Lightning between the years 1809 *and* 1816, *for the most part* 1810 *to* 1815.

Forty Sail of the Line.

Abercromby - 74	*Cumberland - 74	*Queen - - - 98
*Ajax - - - 74	Eagle - - - 74	*Repulse - - - 74
*Armada - - 74	Eagle - - - 74	Roy. Sovereign 110
*Audacious - - 74	*Eagle - - - 74	*Roy. Sovereign 110
*Barfleur - - 74	*Helder - - 64	*Ruby - - - 64
Blake - - - 74	Hibernia - - 120	S. del Mundo - 110
Bulwark - - 74	Implacable - 74	*San Josef - - 120
*Caledonia - - 120	**Kent - - - 74	*Sultan - - - 74
*Captain - - 74	Leviathan - - 74	Swiftsure - - 74
Conquestador - 74	*Magnificent - 74	*Tigre - - - 80
*Cressy - - - 74	*Norge - - - 74	**Tonnant - - 80
Cumberland - 74	*Ocean - - - 98	Union - - - 98
*Cumberland - 74	*Pompée - - 74	Valiant - - - 74
*Ville de Paris - - - 110		

Twenty Frigates.

*Arethusa - - 38	*Herald - - 26	*Nieman - - - 36
*Clorinde - - 44	*Leda - - - 38	*Orlando - - - 36
*Dædalus - - 36	*Loire - - - 38	Palma - - - 48
*Fredereckstein - 32	Minerva - - 36	*Phœnix - - - 36
Guerriere - - 36	*Narcissus - - 36	*Pomone - - - 36
Hebe - - - 36	*Nereus - - 36	*Resistance - - 44
*Revolutionnaire - - 44	*Unité - - 44	

Twelve Sloops and other Vessels.

*Achates - - - 18	*Elk - - - - 10	Opossum - - 18
*Arrow - - - 10	*Goldfinch - - 10	*Sabrina - - - 18
*Bloodhound - 18	*Helicon - - 10	Sheldrake - - 16
*Buzzard - - 10	Morgiana - - 18	*Wasp - - - 18

N. B.—The ships marked thus * had their masts shifted; thus ** two new masts.

All these, with slight exceptions, were crippled by lightning within five years.

No. VI.

A List of certain Ships of the Merchant Navy from 400 *to* 800 *tons, destroyed or severely damaged by Lightning, nearly all since the year* 1830.

Ships Destroyed.

Date.	Name.	Remarks.
Aug. 1852.	Maise.	Struck off Malta; ship went down; crew perished.
May, 1849.	George and Mary.	Set on fire off Scarborough; destroyed in three hours.
July, 1848.	Unknown.	Struck off Boulogne and consumed within sight of coast.
Dec. 1847.	Robert Shaw.	Set on fire off Ushant; drifted and sunk off Portland.
1846.	Thomas P. Cope.	A large liner, set on fire and totally lost at sea.
Nov. 1845.	Bayfield.	Struck by lightning off Sierra Leone, and totally lost.
1841.	Sultana.	Set on fire, and sunk in the China Seas.
May, 1840.	Poland.	Destroyed; crew saved.
1839.	Bolivar.	Burned.
Jan. 1838.	Ruthelia.	Lightning set fire to the cargo; ship destroyed.
	Lydia.	Burned by lightning at sea.
1830.	Boston.	Ditto.
June, 1835.	W. Scott.	Set on fire in the Bay of Biscay; went down within an hour.
Dec. 1832.	Logan.	Burned at sea; had on board 75,000 dollars.
Jan. 1820.	Tanjore.	Burned off Ceylon; two men killed.

Partially Destroyed or Severely Damaged.

July, 1850.	H. M. Str. Clyde.	Struck on passage from West Indies; spars shivered, &c.
Dec. 1850.	John Bryant.	Set on fire; towed into Dublin and scuttled.
Dec. 1849.	Flora Mure.	Spars shivered; hull shook; in danger of sinking at sea.
Mar. 1846.	Bombay.	Severely damaged at sea; East Indies.
Aug. 1845.	Berlin.	Three masts struck; ship set on fire off New York.

Date.	Name.	Remarks.
May, 1843.	Toronto.	Conveying emigrants; spars shivered; all on deck knocked down.
June, 1843.	Marian.	Conveying troops; set on fire; five men killed off the Cape.
Aug. 1843.	R. M. St. Medway.	Spars shivered at sea, &c.; had 75,000 dollars on board.
April, 1842.	Malek al Bahar.	Conveying troops, China Seas; great destruction.
Aug. 1842.	Defiance.	Conveying troops and combustibles, China; all but blown up; spars shivered.
May, 1840.	Elphinstone.	Sails burned; two men killed; other serious damage—India.
May, 1839.	Madras.	Much damaged; a hole knocked through the side; was nearly blown up.
Feb. 1839.	John and James.	Hole struck through side; ran into Malta in a sinking state.
Feb. 1838.	Orwell.	Set on fire at sea; towed, burning, into Liverpool.
May, 1828.	Marquis Camden.	Struck at sea and severely damaged.
April, 1827.	New York.	Nearly beaten to pieces in the Gulf Stream.

Remarks.

The circumstances attendant on most of those cases are quite frightful. The "Bayfield," struck off Sierra Leone, was about 400 tons. The master and crew were knocked down senseless, the vessel's timbers trembled under the shock, large splinters of the spars covered the decks. The electrical discharge passed by the masts into the hold, and in a few minutes the ship was on fire fore and aft; the master and crew were driven to the boats, and finally witnessed the total destruction of their vessel. After intense privation, they reached Sierra Leone.

The burning of the "Walter Scott" is described in the Annual Register for 1835. Lightning shivered the foremast, entered the forecastle, and completely raked the vessel, set fire to the cargo so thoroughly, that the captain, crew, and passengers, roused from their beds, hurried at once into the boats; within an hour the ship went down. Mrs. Hamilton and Sir Isaac Coffin were passengers in this vessel. The seamen, struck senseless, were with difficulty got into the boats. "The moment the long-boat and the gig left the vessel, the masts went over the side; the flames burst forth in greater magnificence than ever; the thunder still roared, the lightning flashed, and the two small boats were speedily left alone upon the billows." After much suffer-

ing, during the remainder of the day and succeeding night, they were picked up by the ship "Saladin."*

The ship "Poland" was burned in a similar way. The electrical discharge ran down the foremast, the cargo caught fire, and after burning for nearly a week, the people on board were happily rescued from their sufferings by the ship "Boston."

The case of the "New York" packet ship, struck by lightning in the Gulf Stream, April, 1827, is described in the Report "Shipwreck by Lightning." The links of an iron chain were not only melted, but fused so as to burn like a taper. The ship lurched or recoiled under the shock so violently as to throw the people down on the deck; the spars suffered severely, and the butts of three five-inch planks were started in the side; all the bulk heads below smashed; the ship was twice struck;—a third discharge would have certainly led to her destruction.

The "Berlin" was struck on all three masts, and set on fire: they ripped up the decks, with the aid of the crew of another vessel, and at last got the fire under.

The "Madras" had a hole a foot square struck through the side, upper deck was burst up from side to side, rigging and ropes cut and burned; chain sheets knocked in pieces, links strewed the decks, all the larboard side of the ship was on fire. Two cartridges of gunpowder exploded, and two barrels set on fire externally; but these with others were speedily thrown overboard: "the escape of the vessel was truly miraculous." She was struck by lightning at sea on her voyage to Calcutta, by two successive discharges, the first shook the spars, the second damaged the hull.

The following protest of the Master of the "Orwell," is not an unimportant document in illustration of the destruction of ships of the Merchant Navy by lightning.

"That on the 19th of February, 1838, it blew very hard from N. W., with heavy squalls and rain; the gale continued all night, and was accompanied by a great deal of thunder and lightning: that at half past two P. M. on the following day (20th February) the ship was struck by the lightning, which set fire to, and burnt nearly the whole of the sails, did considerable damage to the masts, spars, and rigging, and knocked down the master and several of the crew; that the heavy rain soon extinguished the fire in the rigging, but immediately afterwards they found that the vessel was on fire in the lower hold, and that the spare sails in the cabin were also burning: that all hands were immediately set to work to cut away the cabin and deck to get at the fire; and, finding it increasing, they hove down a quantity of water amongst the cargo, at the same time throwing everything overboard that came to hand in the cabin: that after cutting through into the

* This description of the loss of the Walter Scott, (not the Sir Walter) seems to apply to the loss of the Boston, as Admiral Sir Isaac Coffin was in the latter, and I think could not have been twice wrecked by lightning.
R. B. P.

hold, they found several bales of cotton on fire, and in order to get this extinguished, they had to throw some of the cargo overboard: that after great labor and exertion they at length succeeded in getting the last bale of cotton that was on fire from the bottom of the ship, about ten or eleven P. M. all hands were set to work at the pumps, as the vessel was making a great deal of water: that at eleven A. M., on the 21st of February, the vessel *was struck a second time by the lightning, which shivered the mainmast, main-topmast,* and main-topgallant-mast, and damaged the larboard pump."

The following cases of loss, by lightning, are taken from an article under the signature of "E. M.," in the *Journal of Commerce*, of March 22, 1853, some of which are noticed in the preceding pages:—

1830.—Ship Boston and cargo, at sea.
1840, May 16.—Ship Poland, at sea.
1845, Nov. 25.—Bark Bayfield, at sea.
1846, Sept. 17.—Brig Oscar, at Port Spain.
1846, Nov. 29.—Ship Thomas P. Cope, at sea.
1847, Feb. 11.—Christopher Colomb, near Havana.
1848, April 18.—R. C. Fisher, near Highlands of Neversink.
1850, March 4.—Brig Lincoln, at sea.
1847, June 14.—British ship Columbia, off Cape Henry.
1848, July 1.—Pilot Boat Four Sisters, off Sands' Point.
1848, July 29.—A flat boat on the Mississippi, all hands lost.
1846, July 3.—Brig Columbia, off the Balize, all hands lost except the captain.

In addition to these, many ships have no doubt been lost by lightning, with their crews, of which no tidings ever came to hand.

No. VII.

Probability that many Missing Ships have been Destroyed by Lightning.

Upon a careful review of the effects of lightning on ships, but little doubt can arise as to the fact of many of our long missing ships having been destroyed by lightning. The "Peacock" sloop, it is next to certain, perished in this way in 1814; she disappeared on the coasts of Carolina and Georgia on the night of a heavy thunder storm. This vessel was one of a squadron under the orders of the late Admiral Jackson, R. N., then in command of the "Lacedemonian." According to his statement he "spoke the 'Peacock' on her station off Wal-

mington, 12th July, 1814, and made sail to the southward, returned off Walmington again in consequence of the heavy lightning storm to look after the squadron, could not find the sloop on her station, made every search, sent flags of truce on shore, but," he says, "from that day to the present moment not a single particle of that ill-fated vessel has been discovered;" and remarks, "God only knows what her fate was; but from the storm of lightning we experienced, not a doubt is left on my mind of her having been destroyed that night by lightning."

The following is an interesting extract from the remark book of the "Lacedemonian" for 1814:—

"We found the wind very variable in August and September, with heavy thunder squalls at night from N. W., during which vessels are struck by lightning and much damaged; we had two instances in our prizes. The Americans say that vessels are frequently lost on the coast during these months by lightning passing through their bottoms."

A singular instance of this kind occurred in the Bay of Naples on the afternoon of Christmas Day, 1820. Lightning struck the French corvette "Coquin," and "passed through the bottom a little below the water's edge under the gangway on the larboard side." The boats of the squadron then lying in Naples Bay assisted to slip the cables and run the ship on shore in the mole; now if this had happened on a dark night at sea, as was probably the case in the "Peacock," this corvette would have been set down as a missing ship. The "Redwing," "Albicore," and several of the brigs of our Navy on the Halifax station as packets, have perished no one knows how.

According to Steel's list, and many Naval authorities, the "Resistance" 50 guns, one of Admiral Rainier's squadron in the East Indies, was blown up by lightning in July, 1798, whilst at anchor in the Straits of Banca; many circumstances tend to confirm the accuracy of this statement. In this ship, as was then the custom in such vessels, the foremast passed immediately through the fore magazine. According to the testimony of one of the survivors, Scott, afterwards a pensioner at Greenwich Hospital, lightning had been playing round the ship during the night. He states in writing that, "my watch being out at twelve o'clock at night, I laid myself between the two foremost guns on the larboard side of the quarter-deck; about four in the morning I saw the lightning hang about the starboard quarter, then it shot across her larboard bow, and hung there about two seconds, and it pierced down the fore hatchway, and in about five minutes the ship blew up."* There is a peculiar simplicity about this man's statement and of so circumstantial a character, that it seems almost impossible to refuse it. He says further that during the interval, "Mr. James Cuthbert, lieutenant of the watch, went forward to see what was the matter, but he never came aft no more. The arm chest blew up at the time the ship was sinking; that the captain of the after guard was

* Communicated in Scott's hand writing to Sir W. Snow Harris from Greenwich Hospital.

asleep on it with his face down. He heard no thunder; the lightning looked like a cluster of shooting stars about the ship." Nothing was left of this vessel but the foremost part of the quarter-deck. On the following morning thirteen men were found alive on it; of these only four were saved. It does not appear, by various accounts, that anything like a regular thunder-storm occurred. The whole atmosphere, however, was evidently in a state of great electrical excitation, not an uncommon circumstance even in an apparently clear sky.

Although there is not any *absolute* certainty that lightning was the cause of this ship's destruction, yet, if the evidence of the survivors is worth anything, it is certainly highly probable. The case as just stated is one of great physical interest. There was no one stirring in the ship but the watch on deck; it was intended to weigh at daylight. No other cause can be assigned for the destruction of this frigate.

No. VIII.

Effectual Defence of the Royal Navy from Lightning, considered as a question of Finance.

The first returns of the cost of fitting the new conductors in the ten ships selected by the Board of Admiralty in 1830, form no criterion whatever of the actual cost to the Crown, now that the plan is fully carried out in the public service. In fact, when the system was first ordered for trial, it came into the dockyards under all the disadvantages of a new and unpractised experiment, and when the material was twenty-five per cent. above its present value. Mechanical difficulties also had to be met, considered by many as insurmountable; the conducting plates were prepared and applied by tedious and expensive processes, all of which is now rectified, the plates being cut and drilled by machinery, fixings contracted for at a low price, and the whole system economically carried out, according to a set of instructions printed in 1848 by order of the Lords Commissioners of the Admiralty for the use of H. M. dockyards. All the returns hitherto called for with a view of bringing the new conductors into financial disrepute are hence quite fallacious; indeed the shipwright officers voluntarily state, in one of them, that in certain instances the ships are now fitted for *one-third* the amount stated in the returns for certain ships.

If this method of defending the Navy from lightning be dispassionately considered as a matter of finance, the question will be found to stand thus: —

First it is to be observed that the material of which the conductors

consist, is calculated to last for an almost indefinite period of time; the copper plates being either transferable from ship to ship, or reconvertible into new copper sheet, at the small cost of less than four-fifths of a penny per pound;* we are not, therefore, to suppose that all the money expended is absolutely sunk: the conductors once applied to the whole Navy, we should not have to purchase the material over again. Now it is certain that the amount of copper sheet in the government stores would be just as great, whether these conductors were general in the Navy or not; the only difference is, that instead of remaining idle, some small portion of it is doing good service in saving ships from the destructive agency of lightning, and thereby also saving a large sum annually to the Exchequer. The real cost, therefore, of the plan is, to make the most of it, only the expense of labor of fitting, and the depreciation or cost of reconversion of the copper material, to which might certainly be added, in the ordinary run of mercantile affairs, the interest upon the first outlay. But this, for the reason just given, is not virtually an item of expense as applicable to the public service. In the Parliamentary Report, at page 14, will be found an official return for fitting every class of ship, with the actual cost to the Crown, and which takes the material at the mere marketable price of old copper; this should not in strict justice be done, seeing that the plates are reconvertible at a small cost, and are otherwise transferable from ship to ship.

TABLE

Showing officially the actual cost to the Crown, of "Sir W. S. Harris's Lightning Conductors," in the several ships and vessels of the Royal Navy, the reconvertible material being considered merely as old copper (Report of Commissioners):—

Rates.	1st.	2d.	3d.	4th.	5th.	6th.	Sloops.	Brigs.
Cost to the Crown,	£125	£119	£111	£104	£93	£66	£51	£44

We have next to observe, that a ship once fitted does not again involve any further expense so long as she is seaworthy, which should be from sixteen to twenty years; the masts may require to be replaced once in that time, still the conductors are transferable; this should be clearly understood, since it involves an important item in the cost. The actual expense of the plan is at this moment little more than the cost of workmanship, and the loss upon the conversion of the material when sent to the furnaces at Portsmouth; this for a first-rate would not exceed, in round numbers, the small sum of £13. Finally, we may add the labor of cutting and drilling and uniting the plates, which, being now effected for the most part by machinery, is of small amount. The labor of fitting together with the nails does not exceed £50. If

* Return to the House of Commons, April 6th, 1835, printed March 19th following.

we take in round numbers £75 as representing the cost to the Crown, for placing a first-rate line-of-battle-ship, worth £140,000, in security against the fearfully destructive element of lightning for sixteen or twenty years, this is really as much as should be allowed. But let us take the cost at £100; then since the ship as actually provisioned and stored, does not go to sea at a much less cost than £150,000, this will be about the one fifteen-hundredth part of the whole value. Now when we reflect on the vital services for which such a ship is destined—that she is the material element of the power of the greatest maritime country on the page of history—that she is charged with the lives of eight hundred British sailors—will it be said, that a sum not exceeding the one fifteen-hundredth part of her total cost is too great for ensuring the security of so magnificent a structure, for sixteen or twenty years, against the destructive ravages of a terrible element, by which, as we see in the history of the Navy, her services may be at a critical time lost to the country, her seamen destroyed, and a ruinous expenditure entailed upon the public treasury?

The late amiable and intelligent Captain Basil Hall, R. N., in reviewing the question of lightning conductors for the Navy after the report of the Commission, and the great delay and many obstacles thrown in the way of an effectual protection of H. M. ships from lightning, has the following striking passages, which, coming from such a man, are certainly not unworthy of considerable attention. He writes thus *:—

"Ever since I have been at sea, now nearly forty years, I have taken more or less interest in this subject; but it was not till the late Dr. Wollaston called my attention to it, and congratulated the profession on the discovery by Mr. Snow Harris, of a complete safeguard against lightning, that I had any hopes of our ships being effectually protected against this most formidable of all enemies. I confess that when I heard not only Dr. Wollaston, but Sir Humphrey Davy and Dr. Young, as well as many other distinguished men of that day, give it as their opinion that a perfectly safe lightning conductor had been *at last* adapted to all classes of ships, I little thought that upwards of twenty years would elapse, and that the method alluded to should not be now universally adopted. It is, indeed, truly astonishing, that while immense sums are expended on every other description of equipment which can render a ship efficient for the purposes of war or commerce, one of the most important of all—protection from lightning—should be either omitted altogether, or, what comes to the same thing, should not be universally and systematically adopted.

"Everything that wood, iron, and copper can do for strength is now adopted in the construction of the hull of a ship, without one moment's thought about the cost. The masts are fashioned out of the choicest pines, the ropes laid up of the very best hemp, the sails made of the strongest canvas, and even the quality of the pitch and the tar are studied.

* See three very interesting volumes entitled "Patch-Work," by Capt. Basil Hall, R. N., F. R. S.

The ship, above water, is carefully and repeatedly painted, that the wood-work may not be injured by the sun; while her bottom is protected from the action of the sea, and the worm, by a most expensive coating of copper, in the manufacture of which the greatest pains are taken. In ships of war, an extensive supply of guns, powder, and shot, and other means of offence and defence, are placed on board, with not a thought of the cost, only the efficiency of the armament, being ever taken into account. And lastly, a captain, officers, and crew, at wages commensurate to their capacity for working the ship with advantage, are put on board, and half a year's provisions, of the best quality, laid in, at an outlay which must always be very heavy.

"How has it happened, therefore, in these days of intelligence and general improvement, and indifference to expense, when an obviously important addition may be made to the strength and efficiency of our marine, whether naval or mercantile, that so very material an equipment as that of lightning conductors to our ships should have been almost entirely omitted?

"As long as the methods used for this purpose were either not sufficient, even when duly attended to, or were so inconvenient when available as to cause more trouble than the risk was often thought worth, it is easy to understand why all ships should not have been fitted with lightning conductors; but when a perfectly efficient method of protection had, at length, been devised and fully tried and found effective in all cases, and when that method is found to require no extra care, causes no inconvenience, is always in its place, and cannot by possibility be removed from it, and when it costs scarcely anything in comparison to the other equipments freely lavished on every ship, it is very difficult to conceive how any vessel can be allowed to put to sea without this system of preservation from lightning."

No. IX.

Ships and Vessels of the Royal Navy struck and damaged by Lightning since the year 1842.

*25. Bittern 16. Fitted with conductors of wire ropes for trial, royalmast shivered; discharge descended on deck, and struck down eight men.

85. Hazard 18.—Fitted with wire conductors on trial; conductor carried away; topsail sheet-bitts damaged; great explosion between

* The numbers refer to Cases in No. I.

decks; strands of the wire rope broken; copper torn off ship's bottom.

86. HAZARD again struck.—Main-topgallant and royalmast shivered in pieces; also main-topmast, part fell and stove in deck; mainmast damaged; part only of charge escaped by the wire conductor over side.

4. ADVENTURE, Naval Transport, in 1850.—Spars shivered; sails damaged; not ordered to fit the conductors in this class of vessel.

70. FANNY, Admiral's Cutter at Portsmouth.—Vessels of this kind, principally employed in harbor service, were thought so little likely to be damaged by lightning that no care had been taken to guard them against it.

170. ROYALIST 10.—This was a small surveying vessel in India; no opportunity appears to have occurred of placing the vessel in security from lightning; of all other vessels, however, vessels of this class with their valuable instruments, charts, &c., most especially require to be effectually guarded against lightning; the results of a valuable survey may be entirely lost.

The effects of the electrical discharge in the first three of these instances fully confirm the opinion advanced by the Naval and Scientific Commission, viz., that conductors of small capacity under the form of rigging were "temporary and inadequate expedients, and liable to lead to dangerous consequences."—*Report, Shipwreck by Lightning*, pp. 6 and 11. There is no doubt but that such wires may, under favorable circumstances, transmit large quantities of atmospheric electricity, but this is not the question at issue. Dr. Franklin found that common bell-wires had occasionally transmitted heavy shocks of lightning. The great question here is, to apply such a capacious, secure, and efficient conductor to a ship as may be always in place, always ready to meet the most unexpected danger, to be independent of the officers and crew of the ship, and not impose upon them the task of its correct application, or expose them to danger in handling, placing, or replacing it; and to be so applied, that lightning falling on the ship, the electrical discharge could not possibly enter upon any circuit in its course to the sea, of which the conductor does not form a part. It is a fatal objection to temporary conductors as rigging, that they are always liable to derangement, and require constant attention; and it is now proved, that a small wire conductor partially applied to one mast does not defend the others. It was found requisite, in the trials instituted by the First Lord of the Admiralty in 1840, to apply a wire to each mast, hence the sailors have in a ship three such conductors to look after instead of one. In the course of these experimental trials, we find the wire conductors sent ashore from H. M. ships "Impregnable" and "Belleisle" into Plymouth as defective from the chafe of the rigging. In the "Queen" and other ships, they were constantly misapplied, and often carried away. The following is an extract, for example, from the log of the brigantine "Fair Rosamond."

"H. M. Brigantine 'Fair Rosamond,' 22d March, 1842. Observed lightning conductor carried away; spliced the conductor," &c.

"H. M. Brigantine 'Fair Rosamond,' 23d March, 1844. Found lightning conductor gone."

The vast amount of damage recorded in No. I. is alone sufficient to show that, from whatever cause, no effectual means of securing the Navy from lightning had been arrived at in former years. Cases No. 65, 69, 155, and 190, No. I., show the necessity of a conductor to each mast.

No. X.

Instances of the Preservation of certain Ships of the Royal Navy from the Destructive Agency of Lightning.

It is to be regretted, that the numerous instances in which H. M. ships have been preserved from lightning through the instrumentality of the general system of permanent electrical conductors have not all been officially reported, and this upon the ground that no damage had been experienced; in some of those instances, the phenomena are merely noticed in a general way, in others they are passed by altogether, the preservation of the ship from the destructive effects of the electrical discharge being considered as a matter of common occurrence; the log, for example, of one of our 90-gun ships, struck by a heavy flash of lightning in the Piræus, runs thus:—"P. M., lowered topsails to a squall; 1h. 20m., a steam vessel passed; 1h. 30m., struck by lightning; 1h. 50m., hoisted topsails, trimmed as requisite," &c., so that the preservation of H. M. ships from lightning is now received as a matter of course; certainly a most conclusive fact of the value of the new conductors.

The following authenticated and remarkable instances, however, in which capacious electrical conductors, forming an integral part of the ship itself, have preserved the general structure, together with those on board, against the destructive element of lightning, may be considered as so many grand electrical experiments on the gigantic scale of nature, and are hence of singular importance, not only to the department of physical science to which they relate, but they are also of no small consequence to the public interest and the welfare of the Royal Navy.

1. Actæon 26. Coast of Central America, 23d July, 1841.—Dark night, heavy squalls of rain, thunder, and lightning; ship running with square yards. A tremendous crash fell on the mainmast; the vivid light blinded for a time the men at the wheel; the electrical discharge was observed on the conductor; no damage ensued. The conductors saved the spars.—*Report by C. W. Bonham, Lieut. R. N., then mate of the watch.*

"When off the coast of Central America, in H. M. S. "Actæon," on the morning of the 23d July, 1841, I being officer of the middle watch, having heavy squalls of rain, thunder, and lightning, had shortened sail, and was running with square yards, wind to the eastward, sky very dark. Whilst standing on the larboard side of the quarter-deck, between the mainmast and binnacle, and looking towards the main-top, a most tremendous clap of thunder burst over our mast-heads, the lightning appearing at the same time to run down the conductor. There was no interval of time that I perceived, between the flash and the report of the thunder; I saw nothing for several minutes after; the Quarter Master of the watch, Henry Love, also observed it, and said to me afterwards, it was the sharpest lightning he had ever seen, and was surprised that we were neither of us injured by it. I believe the conductor saved the mast, and probably some men's lives.

(Signed) "C. W. BONHAM, *late of H. M. S. Actæon.*"

Mr. May, the carpenter of the "Actæon," states that at the time the cloud burst on the ship,—

"He was standing with his back against the pump winches, near the mainmast, when there came a crash of thunder directly overhead, as if the ship's broadside had been fired. He says it was an awful sound, and attended by a loud whizzing noise; the ship fairly shook under it. He felt the pump gear, against which he was leaning, tremble; the cutlasses, stowed about the mainmast, rattled in the stand; a momentary vivid flash seemed to strike the conductor, the effect of which in discharging the lightning was truly beautiful. The night was awfully dark, with a heavy sea; no damage or inconvenience was experienced; he examined the conductors, as carpenter of the ship, after the squall, and found them quite perfect."

This was not the only instance in which the conductors saved the "Actæon" from damage.

2. ALBATROS 16. Off Fernando Po, Coast of Africa, 10th and 11th Jan., 1847.

"H. M. sloop under my command, at 10h. P. M., on the night of the 10th of January last, 1848, being then a little to the eastward of the island of Fernando Po, was struck by lightning during a heavy thunder-squall, and the electrical fluid carried off harmlessly by the conductors with which H. M. ship is fitted.

"The electrical fluid passed down the conductor on the mainmast, if not that on the foremast also.

"On the following night the sloop was again struck, but not the slightest damage was sustained."—*Report by Commander A. Farquhar.*

3. AMERICA 50. Corunna, 30th Jan., 1847.—4h. 45m. P. M., foremast struck by lightning, which passed off without damage, on starboard side of lower deck, by Harris's conductors.—*Ship's Log.*

A tremendous clap of thunder, preceded by vivid lightning, is reported to have fallen directly on the foremast of the "America," on the evening of the 30th January, 1847, which, as stated in the official report of the ship's qualities, &c., was immediately carried off by the

conductors without any damage having occurred. The ship was at anchor at Corunna, and those on deck who witnessed the explosion made an immediate report to the captain. The day had been cloudy and threatening, followed toward the afternoon by heavy rain, with sharp lightning and thunder. The following is the statement made in the ship's official Journal :—

"H. M. ship 'America,' at Corunna, Jan. 30, 1847, P. M., 4h. 45m. Fresh breezes N. N. W.; cloudy, with lightning, thunder, and rain. Foremast struck by lightning, which appeared to escape by Harris's conductor on starboard side of the lower deck."

The system of conductors carried out in this ship evidently dispersed a severe shock of lightning with great ease, such as under similar circumstances has shivered the spars, and caused other damage.

4. Asia 84. Tagus, at anchor, Nov., 1831.—Squalls and cloudy, with rain, thunder, and lightning; a vivid flash with an instantaneous clap of thunder burst on the mainmast; no damage ensued. Had the mainmast not been fitted with the conductors the masts would have been shivered.—*Report by W. Sadler, R. N., Master of the ship, then on deck.*

"At the close of the day a gale set in from the west, accompanied by clouds, with rain, thunder, and lightning. During a heavy squall, and whilst standing under the poop awning, in conversation with Capt. Hyde Parker, a sudden flash, with an instantaneous clap of thunder, burst over us. I was convinced that the mainmast had been struck, but being fitted with Harris's conductors, we experienced no inconvenience. I have always felt satisfied, that had we not been so fitted, our mainmast must have been shattered, and I think Capt. Parker was of the same opinion. No official report, however, was ever made upon the 'Asia's' being struck by the electrical discharge."

Mr. Sadler, whose services are well known and appreciated in the navy, was formerly the master-attendant at the Chatham Dockyard; and no one acquainted with him would for a moment question the accuracy of his judgment as a careful observer. It further appears, that in consequence of the thunder and lightning, the people were all sent below, the ship being at the time moored in the Tagus.

5. Beagle 10. First Survey. At anchor, Rio de la Plata, Aug., 1832.—P. M., overcast with dark thunder clouds; a furious electrical explosion fell on the mainmast; the vivid lightning deprived the officer of the watch of his sight for a short time; the ship appeared as if in a blaze of fire, and trembled under the shock; the electrical discharge passed through the ship by the conductors, and no ill consequence was experienced.—*Report by Commander Sullivan, R. N., then Lieutenant of the ship, on deck; also by Capt. Fitzroy to the Admiralty. See Report of Commission, Shipwreck by Lightning.*

The "Beagle," during her late voyages in the southern hemisphere, was more than once struck by discharges of lightning. On one occasion, in the Rio de la Plata, the shock appears to have been very severe. Capt. Sullivan, then first lieutenant of the "Beagle," thus describes the phenomena he witnessed :—

"I was first lieutenant of the 'Beagle,' and was attending to my duty on deck. The ship was at anchor off Monte Video, in the Rio de la Plata, a part of the world often visited by severe thunder-storms. Having served in H. M. ship 'Thetis' a few years before, when her *foremast was entirely destroyed by Lightning*, at Rio Janeiro, my attention became particularly directed to approaching electrical storms. On this occasion the storm was unusually severe; the flashes of lightning succeeded each other in rapid succession, and were gradually approaching. I was watching for them aloft, when the ship apparently became wrapped in a blaze of fire, accompanied by a simultaneous crash, which was equal if not greater than the shock I felt in the 'Thetis.' One of the clouds by which we were surrounded had evidently burst on the vessel, and as the mainmast, for the instant, appeared to be a mass of fire, I felt certain that the lightning had passed down the conductor on that mast. The ship was shaken by the shock, and an unusual tremulous motion could be distinctly felt.

"So soon as I had recovered from the surprise of the moment, I ran down below to see if the conductors there had been affected; and just as I entered the gun-room, the purser, Mr. Rowlett, ran out of his cabin, (along the beam of which a main branch of the conductor passed,) and said he felt certain that the lightning had come down the conductor, for at the instant of the shock he heard a vibrating sound, like rushing water along the beam. Not the slightest ill consequence was experienced; and I cannot refrain from expressing my conviction, that but for the conductor the result must have been serious."

This occurred in August, 1832. Capt. Fitzroy, who commanded the "Beagle," on his return to England, made the following report to the Lords Commissioners of the Admiralty:—

"Previously to sailing from England in 1831, the 'Beagle' was fitted with the permanent lightning conductors invented by Mr. Snow Harris. During the five years occupied in her voyage, we were frequently exposed to lightning, but never received the slightest damage, although supposed to have been struck on *at least* two occasions.

"At each of these times, at the instant of a vivid flash of lightning accompanied by a crashing peal of thunder, a hissing sound was distinctly heard on the masts, and a strange though slightly tremulous motion in the ship indicated that something unusual had happened.

"No objection which appeared to me valid was ever raised against them; and were I allowed to choose between masts so fitted and the contrary, I should decide in favor of those having Harris's conductors: even in the small spars the plates of copper held their places firmly, and increased rather than diminished their strength."

In February, 1842, the "Beagle," whilst under the command of Captain Stokes, was again struck by lightning whilst on survey on the coast of South Australia. Captain Stokes, who has published an interesting account of these voyages, reports "that the electric fluid passed down the mizenmast without injury to the ship or spars. An officer was within a foot of the mast at the time, but experienced no

inconvenience beyond a slight alarm at the instant, when a vibrating rattle occurred." Captain Stokes further states that the spars were still the same, having been fitted with the conductors in 1831, a period of full eleven years—a clear proof, says he "that they do not weaken the masts."

6. BEAGLE 10. Second Survey.—Moored in Port Adelaide, South Australia, Feb., 1842. Ship struck on the mizenmast; no damage; an officer was within a foot of the mast.—*Report by Captain Stokes, R. N., commanding the "Beagle."*

7. CALLIOPE 26. 16th July, 1851.—On passage from Hobart Town to Sidney. 1h. 30m. P. M., altered course to N.; 3h. 30m., out third reef of topsails; 6h., up courses and lowered topsails to a squall; a flash of lightning struck the spindle on main-royalmast, passed down the conductor, and went out through the ship with the force of a 9-pounder, throwing back the tumblers on the lower caps and the butts of conductor on ship's side; no further damage.

The following account was written by an officer of the ship the day after this occurrence:—

"Whilst sitting in the gun-room we were startled by a blaze of light and an explosion as loud as that of a 64-pounder; we had been struck by lightning; fortunately the mainmast conductor received the shock and carried the electric fluid clean through the ship; but for the conductor the 'Calliope' might have been shattered into a thousand pieces. Even after the explosion our fears did not subside, as there was a strong smell of burning sulphur all around; the pumps were rigged, and a strict search made, but the conductor had done its work effectually, and here we are, thankful for our escape; not one of our crew ever experienced so fearful a crash."

N. B.—Compare this case with "Clorinde," 42, No. I., and "Albicore," 8, No. I.

8. CHILDERS 12.—Struck by a heavy electrical discharge in the Canton River, China, 30th Jan., 1847.

"I consider the preservation of the masts entirely owing to our being fitted with Harris's conductors."—*Official Report by Com. Pitman.*

9. CONSTANCE 50. 19th July, 1847. Mazatlan, Coast of Mexico. —At anchor, 2 A. M., gloomy weather; squally, with rain; incessant vivid flashes of lightning, with heavy thunder; 2h. 5m., observed the electric fluid pass down the masts; daylight, examined conductors, found point of main spindle fused.—*Ship's Log.*

"The electric fluid passed down the main and fore masts, but the conductors were so well fitted that no damage ensued."—*Ship's Report, signed by the Officers.*

Compare this case with "Audacious," 20, No. I.

10. CONWAY 28. Algoa Bay, 5th Sept., 1844.—At night; a heavy gale; very dark; awful thunder and lightning; a loud explosion burst over the foremast; the people engaged in reefing the main-topsail; saw the lightning stream over the conductor—no damage.—*Reported to the Captain by the Officer of the Watch then on duty.*

11. CONWAY 28. Port Louis, Isle of France, 9th March, 1846.—Ship refitting; topgallant-masts on deck with a pendant staff aloft for the pendant; heavy thunder clouds, with lightning and thunder.

"11h. 45m.—The pendant staff at main-topmast-head was shivered in pieces by lightning; Harris's conductor carrying off the fluid without further damage."—*Ship's Log.*

12. DAPHNE 18. Monte Video, at anchor, Feb. 9, 1843.—Struck by lightning on the mainmast, which passed off by the conductor through the ship without any inconvenience or damage.—*Official Report by Capt. Onslow to the Board of Admiralty.*

13. DIDO 18. Off Java Head, May, 1847.—Ship under sail; a vivid flash of lightning with a burst of thunder struck on the main-royal yard-arm and head of the main-topgallant-mast; the yard was shivered in pieces and the truck split, but the conductors on the masts effectually carried off the discharge without any further damage.—*The Master's Report and Ship's Log.*

The general and permanent protection from lightning, now under consideration, experienced in this ship a most severe trial, off Java Head, in May last, 1847, in the course of her passage to New Zealand, a part of the world notorious for the prevalence of severe and terrible thunder-storms.

It appears, by the accounts from the ship, that soon after daylight, there being at the time heavy rain, with little wind, thunder and lightning, a vivid and fierce discharge fell aloft, in a double or forked current, upon the main-royalmast; one of the branches struck the extreme point of the royal-yard-arm, and, in its course to the conductor on the mast, demolished the yard, and tore in small pieces, or scorched up, the greater part of the sail; the other part fell on the vane, spindle, and truck, which last was split open at the instant of the discharge seizing on the conductor. From this instant, however, when the conductor had, as it were, got complete possession of the electrical agency, the explosive action became arrested, and, as stated by the master of the "Dido," "the discharge freely traversed the whole line of the conductor from the mast-head downward, without doing further damage." It vanished, as it were, in the sea, effectually conducted through the ship, which, nevertheless, "felt the shock through her whole frame. No one on board was injured;" and the conductor is considered by the officers to be "a complete safety-valve."

So perfect appears to have been the harmless dispersion of this great electrical accumulation, that "the conductor on the masts manifested no appearance that would lead one to suppose that the electrical agency had passed down it." One slight effect of disruptive action, however, occurred, clearly showing that it must have done so, and with no small degree of force; a portion of the leather lining about the main-topmast-cap appeared to have been scorched and shrivelled in the passage of the charge from the conductor on the topgallant-mast over the topmast-cap. On examination, the copper hinge, or tumbler, usually placed on the cap, for the more perfect union of the conductors on the respective masts, was found missing. It is, however, on a full consideration

of the case, nearly certain that this effect resulted from the passage of a branch portion of the charge over the main-royal having fallen obliquely and struck with explosive force on the topmast-cap; even although the hinge-piece were wanting originally, it is not likely that the leather on the cap would have been shrivelled up in the way described. The whole of the royal and topgallant-mast was evidently involved in the blaze of a great electrical and fiercely dividing spark, marking, as is usual, the points on which it strikes by violent disruptive effects. The result, however, is rather satisfactory, as being an evidence of the progress of the electrical discharge on the line of the conductor.

Any one who for an instant reflects on the series of terrible effects of lightning on shipboard, as exemplified in the many instances of ships struck by lightning, cannot hesitate to admit that, but for the transmitting power of the conductors, and general truth of the whole system, the mainmast of the "Dido" must have been shivered into atoms, the ship probably disabled, and some lives have fallen a sacrifice. We have pretty good evidence of this in the case of the "Clorinde," struck by lightning in the same part of the world in March, 1813, about four miles off Friar's Head, on the east coast of Ceylon. Here the spars were shivered in pieces; only a wreck remained; the maintopmast was literally cut in two; three men were killed and five wounded; and the ship obliged to give up her voyage, and go to Trincomalee for refit.

Remarks on this Case.

From the occasionally perilous and variable manner in which lightning falls on ships, it is not always possible to cover protectively projecting bodies such as the yards. In about seven times in ten a concentrated discharge will fall bodily, as it were, on the highest point, and if there be attached to that point a capacious line of conduction to the sea, it will be securely transmitted. But instances are occasionally found in which lightning strikes in a direction more or less oblique to the ship, so much so, as to fall on the jibboom; as in the cases of the "Sultan" and "London," and in some others; it may fall immediately upon the deck or into the body of the vessel, as seen in the cases of the "Spartiate," "Semiramis," and "Romney." Such instances, however, are rare. The cases in which lightning strikes the yard-arms, so as to destroy the yard, are also rare, although many are found in which the yards and sails are involved in the general destruction attendant on the passage of the electrical agency along the spars under an explosive form.

It is now incontestably proved, by a large experience and induction of facts, that metallic bodies have no inherent affinity for the matter of lightning, and exert no active influence whatever in attracting or drawing it aside from its chosen path, except by presenting to it passively a line of less resistance than that in which it is about to move; so far the action of the lightning-conductors we are now exemplifying may be within certain limits beneficial, in preventing a discharge from falling

or continuing in an inconvenient direction; but otherwise, they have really no attractive power proper to themselves in drawing it aside, their action is consequently purely passive; they operate in the way of rain pipes, only in carrying off the electrical discharge which falls on them. They are rather the patients than the agents, and they can only so far defend bodies to which they are immediately applied. It is therefore quite impossible to defend a yard with its attached sail by a conductor on the mast, should the course of the discharge be in that direction, since we cannot dictate to the electrical agency how, and in what way, it shall approach the ship. Such projecting points are, therefore, liable to be assailed as in the present instance, and we cannot possibly protect them except by perfecting the conducting power of the yard which might prove troublesome and inconvenient to carry out as part of a general system, although still possible to be done.

Supposing only the small conducting power of the mast to be in operation, without the metallic conductor, then, as is evident upon these principles, the stroke of lightning would descend at once upon the nearest point, and upon the general body of the mast and sails, shivering and destroying with repeated explosions everything in its course; for the mast being already a conductor of electricity to a certain extent, will always afford to the electrical discharge an easier path than the air, except under some new and extraordinary circumstances, such as conducting matter in the air itself, or other disturbing causes.

It will be hence seen, that nothing short of a conductor attached to the mast itself could protect the ship in such cases; any temporary kind of chain or rope of wire, appended from the truck and led at a great angle along the backstays over the ship's side, would in this instance of the "Dido" have certainly not defended the mast against the current which struck the yard-arm. The case of the "Hazard," before referred to, is conclusive upon this point.

Finally, it is to be observed, that the escape of this ship under the circumstances detailed, and the protection afforded by the conductor, is certainly most marvellous and satisfactory, and furnishes an instructive example of the great practical value of experimental and inductive science — the destruction of the royal-yard *without* any conductor attached to it, and the security of the royalmast *with* a conductor, is a complete crucial experiment, if such were wanting, and speaks volumes.

14. Druid 44. Rio de Janeiro.—"Awful lightning" passed down the fore and main masts without damage.—*Parliamentary Report on Harris's Lightning Conductors*, p. 90.

15. Dryad 44. Coast of Africa, Jan., 1831.—Struck on fore and mizen masts during a tornado; the lightning was observed to pass down the conductor, attended by a whizzing noise—no damage ensued.—*Parliamentary Report*, p. 29.

Captain Turner, R. N., late of the "Dryad," states in evidence — "That in a tornado, on the Coast of Africa, both the foremast and mizenmast were struck by lightning; the ship appeared enveloped in flames; the thunder was very loud, and instantly suc-

ceeded the lightning." He further states, "That whilst standing on the quarter-deck during one of the flashes, I distinctly saw the lightning run down the conductor on the foremast, and the officer on the forecastle came and told me he heard a hissing noise, resembling the boiling of water; all the men there heard it also. A short time afterwards, several of the officers standing abaft saw it, at the time of another flash, go down the mizenmast, and heard the same hissing noise."

In allusion to the conductors, he adds, "Carrying sail has no effect upon them; we carry a heavy press of sail sometimes."

16. FAVOURITE 18.—"Lightning has at several times passed down the conductors, but without doing any damage whatever."—*Ship's Report.*

17. FISGARD 42. Nisqually River, Oregon, 26th Sept., 1846.—Ship at anchor, 7h. 45m. P. M., the mainmast was struck by lightning, the electric fluid passing down the conductor and out at both sides of the ship, with a very loud explosion, but doing no injury.—*Ship's Log.*

The following account is by the senior lieutenant of the ship.

"A violent thunder-storm commenced about 6 P. M. As I was speaking to one of the men relative to the lightning, the electrical discharge burst over our heads, striking the mainmast and passing down the conductor within three yards of my body; a seaman near me was temporarily blinded, and fell on the deck; the electric fluid passed off by the conductor with an explosion beyond all description: it stunned everybody on board. Thanks to the conductors with which our masts were fitted, no damage was sustained."

A terrific explosion of thunder and lightning is reported to have fallen on the mainmast of the "Fisgard" on the evening of Saturday, the 26th September, 1846, whilst at anchor in the Nisqually River, in the Oregon territory.

From a careful review of the official and other documents relating to this case, it is apparent that the ship experienced one of those bifurcated discharges of lightning so frequently observed at the instant of a vivid and intense explosion falling on elevated bodies. The current of lightning evidently divided on approaching the mast, and struck simultaneously on the vane-spindle aloft, and on the lower mast, from three to thirteen feet above the deck. The extremity of the vane-spike was found to have been fused, and the conductor started from the mast in three places, about the point in which the discharge struck below.

The following statement includes the substance of the official letter transmitted by Captain Duntze, of the "Fisgard," to Rear-Admiral Sir George Seymour, C. B., &c. &c., Commander in-Chief in the Pacific, and forwarded by him to the Lords Commissioners of the Admiralty, dated Nisqually, Puget's Sound, 30th September, 1846:—

On the 26th inst., at 7h. 45m. P. M., the mainmast was struck by lightning—a very vivid flash, succeeded by a loud report, as if a broadside had been fired from each side of the ship, was observed by a

senior lieutenant, then on deck, to strike the mainmast. The next morning, on examining the conductor along the mast, the vane-spindle was discovered to have been fused at the point, and blackened one-third of the way down. There were no marks on the conductor of the royal or topgallant-masts, except at the part covered by the cap, where it appeared blackened, and the heads of the nails slightly fused. The conductor on the main-topmast exhibited no marks whatever. The conductor on the mainmast, low down, was found to have been started from the mast in three places—one just above the spider-hoop of the awning, another just below this, and another below this again: (according to the surgeon's meteorological report, the respective distances were, twelve and a half, seven and a half, and two and a half feet above the upper deck.) The plates of copper forming the conductor were separated at the lowest point, and thrust, as it were, asunder; the edge of the groove, in which the plates were laid, was slightly rent by the starting of the plates, thereby causing two or three splinters to fall on the deck at the time of the discharge. The electrical current having passed down the mainmast, took the direction of the branches to the bolts through the side—one leading through the boatswain's cabin, and the other through the midshipmen's berth. The branch conductors in this ship, instead of leading directly to the copper sheathing, near the water's surface, as originally proposed, had been led out above it, to two bands of copper passing down externally over the ship's side; these bands were also started at the ends in contact with the termination of the through bolts, the copper sheathing covering the other extremity of the band was bulged outward. It appears further by other reports, that at the point of contact with the branches and the iron knees within the ship, the metal appeared blackened, as if a slight expansive action had occurred in these points; this is said to have been more apparent in the boatswain's cabin, and may have arisen from an imperfect contact with the iron knee and through bolts. No ill consequence, however, resulted.

Captain Duntze also states that a boatswain's mate, standing abaft the mainmast, on the starboard side, was reported to have been blinded at the moment by the intense light, and to have been knocked down on the deck; one of the midshipmen also on the starboard side, on the main-deck, near the mast, felt himself thrust, as it were, aside, but without falling. This is a direct result of expansion on the air. Dr. Dunn, the surgeon of the "Fisgard," remarks in his report, that there is some difficulty in determining how far the boatswain's mate was struck down by the direct influence of electricity; he appears rather to have fallen down by the concussion and panic of the instant. The senior lieutenant, standing close by, and within three yards of the mainmast, experienced no effect whatever; and it is to be noticed as a remarkable and most important fact, that one of the gentlemen in the midshipmen's berth was leaning at the time of the shock with his elbow resting against the thin batten or casing covering the conductor, his head at the same time resting on his hand; so that it was within a few inches of it. He describes the effect as being similar to the report of

a pistol fired close to the ear, but says he did not experience any electrical shock, or any other inconvenience. And this is not a solitary instance of such a result. We find it also apparent in the cases of the "Beagle," "Scylla," "Daphne," and "Fox," fully showing that the result was in no sense accidental, but may be considered as general.

When it is remembered that the electrical discharge, or at least that portion of it which passed through this branch of the general line of conduction, exploded externally upon the sea with terrific violence, and did actually start the copper bands on the exterior of the ship from their bearings, it is quite impossible not to be impressed with the truth of the general deduction, that the agency of lightning finds its way through the best or least resisting course, without regard to adjacent matter, or any liability to what has been erroneously termed "lateral discharges," and that, consequently, by providing for the agency of lightning a very capacious, continuous, and least resisting course from the highest points of a ship to the sea, protection to the general fabric must necessarily result. In fact, Captain Duntze thus concludes his very interesting and clear official report relative to this case:—"*Mr. Rodd, the senior lieutenant, gives it as his opinion, from the severity of the shock, that had it not been for the efficiency of the conductors the mainmast must have been totally destroyed, and much serious damage have occurred, in which opinion I fully coincide.*"

This storm appears to have been of no ordinary kind, several of the pine trees on the neighboring land were found to have been struck by the electrical discharge and set on fire. The people on shore employed on work for the service of the ship, state that the lightning repeatedly struck the ground in all directions; the ship appeared covered in fire, and the whole atmosphere in a general blaze, with terrific bursts of thunder. According to Dr. Dunn's intelligent Meteorological Report, "Thunder and lightning are not frequent in this part of the world, but it would appear, that towards the end of autumn, when the weather begins to break, the periodical change is ushered in by electrical phenomena." On this occasion the day had been dark and gloomy, with heavy falls of rain. The thunder-clouds were observed by the first lieutenant to gradually approach the ship with frequent discharges of lightning. The effect was such, when the explosion fell on the mast, as to cause a sort of momentary panic, attended by a death-like silence. Some of the seamen who were smoking, involuntarily took the pipes from their mouths and laid them down, and the band, which was performing some music at the time on the quarter-deck, suddenly ceased. The first impulse was to open the cocks and let water into the ship for the use of the engines, under an impression that from the extreme and awful violence of the discharge, something serious must have happened.

Such are the principal facts in the history of this interesting case, and which are most important as furnishing conclusive evidence of the protection to be derived from continuous and capacious lightning conductors on shipboard, applied in the way we have described. Here is

indisputable evidence that as powerful a discharge of lightning as can be well imagined, fell with force directly on the mainmast of the "Fisgard," which expended all its fury on the conductor, and was, by its protective influence, led securely to the sea, without the slightest damage or inconvenience. We trace it from the points on which it first struck, up to the very sea in which it finally vanished, and we find the ship unharmed and still efficient, amidst the blaze and crash of the most terrible element in nature.

That the lightning fell on the vessel in a double or forked stream is quite apparent: in fact, it was at first supposed, as stated in the Meteorological Report, "that the lower mast *alone* had been struck by a concentrated discharge, but on lowering the copper spindle from aloft it was discovered to have been fused, and a minute red shining globule formed at its extremity." Indeed it was this circumstance alone which led to the discovery of the lightning having also fallen aloft, and of which it furnishes complete evidence. The fact of the lower mast having been struck low down is equally demonstrable by the starting of the copper plates, and by the mast appearing slightly singed in this place; for there is no sufficient reason why such effect should have occurred here more than in any other point above it, except from a direct burst of the electrical explosion upon this part of the mast; but the conductor was examined from the truck downward, and no effects of this kind perceived until within about thirteen feet of the deck. Now it is well known as a law of electrical action, that the immediate points of exit and entrance of lightning into conducting bodies are those in which the most violent expansive effects occur; hence the starting also of the copper bands upon the exterior of the ship at the instant the discharge left the conductor to explode upon the sea. It is also stated in the official Meteorological Report, "that several boarding-pikes, ranged round the mainmast, were displaced, and their wooden stand slightly charred,—further showing that a burst of lightning had occurred about this point. Expansion upon the air is one of the most powerful results of electricity; hence the expansion in striking the mast, low down, would be necessarily severely felt, and would sufficiently account for the fact of one of the officers feeling himself, as it were, "thrust aside, but without falling," which is in fact, a direct result of expansion, and marks the fact of the lightning falling upon the mast, near the deck. The first lieutenant further states, that at the time the lightning struck the ship he was sensible of three distinct effects. *First*, a vivid and intolerable glare of light: *secondly*, a sharp, ringing, crashing sound, almost indescribable, and which he characterizes as the explosion of lightning in the water: *thirdly*, the terrific burst of thunder over his head: all these followed close upon each other, with a scarcely distinguishable interval of time between them. Now, it is not improbable that these two latter effects may have resulted from the fact of the double discharge—the one striking a little before the other; first on the mast, low down, close to the deck; the other at the royalmast-head, 200 feet in the air, and which would account for the phenomena in question. The whole series of results,

therefore, confirm the conclusion that the ship was struck by a divided, or by two streams of lightning, one part falling on the spike, at the mast-head, the other low down, near the deck.

We have many instances of ships struck by forked discharges of lightning, and by discharges which have fallen low down on the mast; and this last result, whether it proceed from a divided or single stream, no conductor of the ordinary kind can meet; a vessel will be always open to damage in this way so long as the masts themselves, together with the hull, are not made perfectly conducting, throughout.

The following extracts of two letters, one from the senior lieutenant, Mr. Rodd, the other from Lieutenant Dyke, furnish valuable notices of the phenomena we have been discussing:—

"Perhaps few men (observes Lieutenant Rodd) had such an escape as I had on the 26th of last September, when lying moored off the Nisqually River. A violent thunder storm commenced about 6h. P. M., accompanied with heavy rain, lightning gradually approaching the ship; as I was speaking to one of the men, relative to the lightning conductor, the electric fluid burst over our heads, striking the mainmast and passing down the conductor, within three yards of my body. A seaman, who was almost touching me, was temporarily blinded by the vivid light, and fell on the deck. The electric fluid passed off by the conductors on each side of the ship, into the water, with an explosion beyond all description; it stunned every one on board. Thanks to the lightning conductors, with which every mast is fitted, no damage was sustained."

Lieutenant Dyke says:—

"We were struck by lightning about 8h. P. M., on Saturday, the 26th September. The crash was most awful—just as if five hundred broadsides had all gone off together. We had been exercising great guns that day before the Indians, and were already half stunned by the repeated discharges; but it struck us all how ineffectual had been our attempts to make a noise when Nature poured forth her dreadful artillery. The electric fluid appears to have struck the vane-spindle; it then passed harmlessly down the conductor until it reached a point where the boarding-pikes are stowed round the mainmast; here one plate of the conductor was started from the other, after which it passed out on both sides of the ship, causing a good deal of fear, but no danger. We did not trace any portion of the discharge through the ship's bottom.

"No greater proof of the value of these conductors can be produced. I was on deck some time before we were struck; there was then occasional sheet-lightning in the distance, which we took no notice of, as we had observed it for several nights before; there was nothing that would have led us to have got the old kind of conductor up from below, and we were told that lightning in the Oregon was very rare."

18. Fox 42. At Colombo, East Indies, 5th April, 1847.—Ship at single anchor, P. M., 4h. to 5h.; heavy rain, thunder, and lightning; lightning struck the mainmast and passed visibly down the conductor without doing any damage.—*Ship's Log.*

The *Ceylon Times* describes a terrific storm of thunder and lightning as having occurred at Colombo on the 5th of April, 1847, during which H. M. frigate "Fox," Commodore Sir Henry Blackwood, and a merchant-vessel near the "Fox," called the "Bittern," were struck by the electrical discharge. "In the former ship the electrical fluid passed safely off by the lightning-conductors." With reference to the "Bittern," it "entered the fore-hatch, tearing away part of the casing of the mainmast," &c. &c.

No especial report appears to have been made by the Commodore on this case of protection, but the following is an extract from the ship's log, showing that the protection had been most complete:—

"'Fox,' at single anchor, Colombo, Monday, April 5th, 1847.

"Wind S. W. 2h. 30m. P. M. Down topgallant-yards.

"Wind S. E. 4h. 5m. P. M. Squally, with heavy rain, thunder, and lightning.

"Wind S. W. 5h. P. M. Lightning struck the mainmast, and passed visibly down the conductors, through the midshipmen's berth and commodore's steward's berth, leaving a mark in the latter, but without doing any damage."

19. FURY, Steam frigate.—The following is an extract from the Official Report relative to storms of lightning experienced in this vessel:—

"Storms of lightning; truck at fore-topgallant-mast-head split. Mast saved by conductor of Snow Harris."—*Signed*, J. WILCOX, Commander.

20. GANGES 80. 10th Jan., 1850.—In the Piræus, A. M., 1h. 20m., lowered topsails to a squall; 1h. 30m., struck by lightning.—*Ship's Log.*

"The night was extremely dark and squally, with heavy rain. The ship in the Dora Passage, much shut in by land; the electric fluid first struck royalmast; descended to middle of foremast, there bursting like a pyrotechnic shell, it appeared to scatter a shower of brilliant sparks of fire in all directions; this was followed by a heavy peal of thunder; the stream continued to descend the mast without intermission for about forty minutes. There cannot be a doubt that had not the 'Ganges' been fitted with Sir Snow Harris's conductors, the foremast must have sustained serious damage, and probably the ship have been set on fire. The masts were examined after daylight minutely, but they had sustained no injury."—*Report signed by the Master of the "Ganges."*

N. B.—The ship was evidently struck by a forked discharge; one branch fell aloft, the other low down on the foremast, thus conveying the impression of an explosion of the same current which struck aloft, low down on the mast. This is by no means an uncommon occurrence; it happened in case of "Fisgard," No. 17. Compare this case with that of the "Rodney" 90, No. 165, No. I.

21. HOUND 6.—Struck by the electrical discharge on the Coast of Africa, 15th Sept., 1848. The discharge "fused the conductor at the mast-head, and passed out by the lower deck." No damage was done.—*Signed*, G. H. WOOD, Commander.

22. MINDEN 74. Hong Kong, China, 9th Aug., 1842.—A typhon set in with furious lightning, thunder, and rain; ship at anchor; yards and topmasts struck; ship enveloped in lightning. A loud explosion fell on the mainmast and shook the ship.—No damage done.

"During one of the crashes which shook the ship, I saw the electric fluid fall on the mainmast, and run off in an apparently continuous stream of fire quite frightful to behold."—*J. H. Cook, H. M. Ship Minden.*

The "Minden" was completely fitted with the permanent conductors at Devonport, in 1841, being destined for service in India and China, where storms of lightning are known to be extremely severe. . . . The ship, since the time of her sailing from England, in 1842, has been frequently exposed to such storms, but without receiving the least injury.

Captain Quin reports, that on the 19th July, 1842, whilst in the Straits of Malacca, the ship experienced a severe squall of rain and wind, with thunder and lightning. "The forked lightning fell on the masts and played about the conductor in a truly awful manner." Such, however, was the rapid transmission of the electrical discharge, that no heavy explosion ensued, which Captain Quin "attributes to the admirable adaptation of the protector."

On the 8th and 9th August, at Hong Kong, a sort of typhon set in with "ugly appearances—rain, thunder, and lightning." Ship at anchor—yards and topmasts struck—jibboom and spritsail yard in, per signal. Thunder, sudden and heavy; lightning, vivid beyond description. According to Captain Quin's characteristic remark, "it was lightning indeed." Ship said to have been struck on the mainmast. Captain Quin states, that an opium ship, named the "John Barry," in the immediate vicinity of the "Minden," had her foremast shivered all in pieces. One of the crew of the "Minden," since arrived in England, states that the concussion of the thunder was such as to convey, to those below, the idea of the shock of an earthquake.

Mr. Cook, the purser of the ship, in a letter written from Hong Kong, and which appeared in the public prints, thus describes the phenomena:—

"The lightning last night was heavier than I ever saw it before; two flashes struck the "Minden," and played about the conductors for a few seconds, conveying a stream of fire through the ship, awful to behold. A frizzing noise was distinctly heard, and I have no doubt but that we should have received serious injury had we not been protected by our conductors. I have been informed that the lightning struck several merchant vessels, killed four men and wounded some others. We are now lying with the fore-yards and topmasts struck."

Besides the protection of the "Minden," in this tropical storm, we find the "Cornwallis" 74, Vice-Admiral Sir W. Parker, also successfully defended against the heavy discharges of thunder and lightning which enveloped the ship. Captain Richards states that the conductors fixed in the masts, completely transmitted the bursts of lightning which fell on the spars. Thus we find two line-of-battle ships on a very crit-

ical service, on a foreign station, perfectly secure in a thunder storm, which on other similar occasions had caused very great devastation, and which did even then shiver the masts of merchant-ships near them, and killed several men. It is not difficult to imagine the serious consequences which might have ensued to the public interest if either or both of these ships had been disabled at Hong Kong, during the late Chinese war, in which they were engaged.

23. PANDORA 6. 1845.—Experienced discharges of lightning four times; no damage.

24. PILOT 16.—Struck by lightning at night, on the foremast, at Trincomalee, in 1844; ship at anchor; the crash was so tremendous as to rouse the people below from their hammocks. The conductor, on examination afterward, appeared somewhat discolored, but no damage was done.—*Captain's Statement.*

25. RACER 16.—"Rio de la Plata, at the Bucco, 27th Feb., 1844, foremast struck by lightning, the discharge melted the copper band round the truck aloft, the vane-spindle not being in place; was then observed to pass off by the conductor; no damage done."—*Report by the Captain.*

"About 4h. 30m. A. M., during a heavy storm of thunder and lightning, the lightning was distinctly seen to run down the foremast; and upon removing the truck (which I have now in my possession) it was quite evident, from a part of the copper rim round the truck being fused, that the lightning had entered there, passed along a bolt of one of the sheaves, and so communicated with the conductor on the mast, which carried it safely off. We have shown the truck to many persons, who all speak highly in favor of the conductors."

This is a direct case of the dispersion of an electrical discharge, which actually melted the metallic band in the place on which it first struck.

27. RACER 16.—Rio de la Plata, Maldonado, E. S. E. 32 miles; ship under close reefed topsails; a thunder-cloud burst immediately over the foremast, filling the air with a strong sulphurous smell; no damage ensued.—*Statement by the Captain.*

27. RACE HORSE, 1845.—Five cases of thunder and lightning; one very heavy; no damage.

28. RANGER 18. Dec., 1850.—Off St. Paul's Head, Coast of Africa. "Lightning struck both fore and mainmast, sky very dark, with heavy rain; could scarcely see across the ship; lightning very vivid; nothing but the conductors saved the masts; had the masts come down, many men must have lost their lives."—*Statement by the Commander.*

The lightning-storm was of two hours' duration, and very fearful, the ship being for the whole time enveloped in electrical discharges: one of the flashes passed safely by the main conductor over the beam in the first lieutenant's cabin, who was at the time sick in bed, rendering the surface of the metal luminous. Commander Miller states that the ship was certainly saved from *partial* if not total destruction.

29. RATTLER, Screw Steamer. 24th Nov., 1849.—At anchor off

the mouth of the Benin River, Coast of Africa, middle watch—a terrific clap of thunder appeared to shake the ship; a flash of lightning struck the main-royalmast and exploded upon the mast with a stunning noise; the officer of the watch thought the mast was gone; no damage ensued.

30. Rolla 10.—Especially affected by thunder and lightning; no damage.

31. Rose 18.—"Ship struck by lightning, 31st July, 1846, at the spindle or main truck, passing down the conductor; no damage."—*Ship's Log.*

32. Satellite 16. 1843 to 1847.—Exposed to heavy lightning; no damage.

33. Scylla 18.—West Indies, at sea, 6th August, 1843; lowered topsails to a squall; ship overspread by a dense black cloud. A. M. 7h. 50m. struck by lightning: "taking its course from the main-topgallant-mast-head down the conductor, starting some of the butts and nails, where the lightning first struck; it passed by the conductors, through the lower deck, without doing any damage." "8h. 30m. made sail, &c."—*Ship's Log.*

The captain inclosed a copy of the log to the Commander-in-Chief on the station, Admiral Sir Charles Adam, G. C. B., with this remark:—"I cannot omit this opportunity of recording my high opinion of the lightning conductors on Harris's plan, and with which the 'Scylla' is fitted. If we had not been furnished with them, the mainmast must have been shivered, and perhaps a more serious disaster would have befallen us."

Captain Sharpe, who commanded the "Scylla," thus describes the circumstance:—

"On the morning of the 6th August, 1843, lat. 24° 3′ N., long. 69° 12′ W., the 'Scylla,' at about 8h. A. M., was struck by lightning, attended with a heavy clap of thunder, which shook the ship to her kelson. The greater part of the morning watch had been one continued and heavy rain, the weather threatening and unsettled, sky overcast with dark clouds, wind unsteady, heavy thunder and lightning, both sheet and forked, and frequent explosions very close to us."

The ship was struck from a cloud densely charged with electric fluid, which overhung the masts; it was raining furiously all the time.

"The course of the lightning was from the main-truck down the mainmast, escaping through the ship, by the various conductors connected with the mast for that purpose." Captain Sharpe further observes, "There can be little doubt that our spars were saved by the conductors, and from their being fixed, I consider them preferable to any I have ever seen."

This seems to have been an extremely powerful discharge, some of the butts of the copper-plates in the topgallant-mast were started by it, and in one place buckled up at the edges; some of the fixings also were shook and loosened. Captain Sharpe states that "no other mast was touched, or felt the least effect from the shock," and that "the topgallant-mast, on which this occurred, was not fitted by the dockyard in England, but was prepared at Port Royal," where the most

improved method of applying the conductors to the spars could not as yet be known. The circumstance may be considered, in an experimental point of view, as a very fortunate one, since it shows how violent a shock the copper-plates could discharge, without any heating effect being produced on them, and without any kind of inconvenience being experienced in the hull of the vessel, or by the conductors themselves, when properly secured.

Mr. Welsh, the carpenter of the ship, and whose duty it is to inspect the masts, states, by permission of his captain, that "on examining the conductor, after the ship was struck by lightning, I found it had started from a butt, about three feet below the truck, at the main-royal-mast-head; it was again replaced in a few minutes," that "neither the ship, nor the mast, received any hurt or damage from the flash or the fluid," and gives it as his true opinion, "that had it not been for the conductors, the mast, if not the ship, must have sustained a serious injury."

It appears also by the ship's log, that such was the excited condition of the whole mass of the ship, and the air immediately under the thunder-cloud, that "various parts, such as the chain cables, coppers, &c., exhibited symptoms of electricity;" it also appears by the log, that "the ship having shortened sail, 6h. 30m. A. M., to a heavy squall from S. W.," was, "at 7h. 50m., during a squall from N. W., struck by lightning," in the way above described. At 8h. 20m., that is, within half an hour, they "made sail" again, and the ordinary duties of the ship went on as if nothing unusual had occurred.

Here, then, we have an instance of a ship rendered perfectly secure from the effects of lightning in the focus of a tropical thunder-storm, and under circumstances of a very threatening and dangerous kind; and which, as appears by the records of H. M. Navy, have in a great variety of similar instances been productive of the most fatal consequences.

34. Talbot 20.—At the Nore, July, 1842. Ship under sail, Sheerness; heavy thunder-squall; the electrical discharge was observed to fall on the mainmast; it was instantly carried off by the conductor without damage.—*Statement by Capt. Sir Thomas Thompson and Lieut. Harper, R. N.*

35. Talbot 20.—"Struck by lightning in October, 1842, off the harbor of Rio de Janeiro; no damage."—*Sir Thomas Thompson, Capt., R. N.*

36. Tyne 26.—Several instances of lightning; no damage. The conductor effectually carried it off.—*Ship's Report, signed by the officers.*

37. Thunder 6.—25th April, and 10th May; heavy thunder-storms; no damage.

38. Vixen, Steam Frigate.—Struck by lightning in the West Indies, 21st June, 1848, off the Island of Gonares.

"The foremast appeared an entire sheet of fire." The mast was struck obliquely aloft; the conductor on the topgallant-mast was cut in two, horizontally, by the force of the shock which fell on it, and several

of the nails which secured it at that point scattered on deck. "The conductor was easily replaced,"—no damage ensued either to the mast or the vessel.—*Statement by the Captain.*

39. WATERWITCH 10.—"On the 20th June, 1841, at 2h. A. M., a heavy thunder-storm; the ship was struck by lightning; it passed down the main conductor and through the ship, furnishing another proof of the value of Sir W. Snow Harris's conductor."—*Official Report by Capt. Quin, dated off Gallenas River, 28th June,* 1849.

40. WATERWITCH.—At sea, off Lagos, Coast of Africa, 9th June, 1852, 1h. 30m. P. M., lightning struck the ship and passed off by the conductor; no damage. "The safety of H. M. sloop is due to Sir Snow Harris's admirable conductors."—*Official Report by Commander Gardner.*

The following cases may with propriety be added as being very important:—

SOUTHAMPTON 50. A very heavy crash of thunder and lightning fell on this frigate's mainmast at Monte Video during her last commission, 1850; Capt. Corry was in bed at the time, and felt the shock upon the ship; the conductor was slightly started from the mast low down; no damage ensued; it happened in the morning watch; men were washing decks, and was thought so little of that the circumstance was not noticed in the log.—*Statement by Capt. Corry.*

SPITFIRE, Steam Frigate, 1846.—Sixteen instances of thunder and lightning; no damage.

FERRET 6. Coast of Africa.—Plenty of lightning. A French brig of war near us had her metal chain fused.—*Ship's Report.* The captain of the "Ferret" states, that the masts of the French brig ("Bouganville") were considerably damaged. The two brigs were near each other.

ASIA 84. Vourla Bay, at anchor, together with the "Powerful" 84, 25th March, 1840.—Heavy thunder-storm; lightning shivered the foremast of the "Powerful," not having the conductors; "Asia" not damaged; the "Asia" was one of the ships in which the conductors were placed for trial.

Mail Steam Ship DEE. Copy of a letter from the Admiralty agent to Captain Austin, R. N., Superintendent of Packets at Southampton.

"I deem it a duty to report to you, that when I was on board the 'Dee' contract steam packet as Admiralty agent at the Havana on the 17th of April last, a very heavy storm of thunder, lightning, hail, and rain, came on just as we entered the port and moored alongside of the coal quay. I was delayed for more than an hour in landing H. M. mails, (as reported in my journal,) and during the violence of the gale the lightning struck the spindle on the mizen-royalmast and bent it slightly, descended harmlessly down the conductors of 'Snow Harris's invention,' and at the same instant of time shivering the spanker-boom of the 'Fernando Catolico' Spanish packet steamer anchored close athwart our ship's stern. Some of the passengers, who were sitting with me under deck, and before the mizenmast, at the moment of the shock, expressed great alarm at the time of it, as its violence was

sensibly felt. The lightning was seen by those on the quarter-deck, quivering in a zigzag form along the chain ridge ropes of the awning, but did no damage. "I have, &c.,

(Signed) "JAMES NEWENHAM, *Lieut. R. N.*"

It is worthy of remark, that between the years 1828 and 1840, upwards of thirty ships in which the conductors were placed, had been exposed to lightning in all climates, without sustaining any damage; whilst for the rest of the Navy on different stations and not so protected, there were damaged by lightning 7 ships of the line, 7 frigates, 30 sloops, and 6 smaller vessels and steamers, making in all 50 ships; and averaging more than one-fourth of the Navy annually in commission. There were probably more, but we have authentic documents for these.

Taking a period of 22 years, during which ships of the Navy were at sea, some with, and some without, the new electrical conductors, it is found, that those without the conductors were more frequently struck by lightning than those with, in the proportion of three to two. The notion, therefore, that such conductors attract lightning to a ship is contrary to a large amount of experience.

In No. I. will be found many very appalling instances of the fatal effects of lightning on ships of the Royal Navy on the Coast of Africa. See cases of "Clinker," "Columbine," "Medina," "Pelican," "Squirrel," numbers 41, 43, 113, 136, 193; and compare those with cases of "Albatross," "Dryad," "Hound," "Ranger," "Rattler," "Waterwitch," numbers 2, 15, 21, 28, 29, 39, 40, given in No. X., and in which no damage whatever occurred.

No. XI.

List of Ships of the Royal Navy preserved from Lightning between March, 1846, and July, 1847.

Albatross	16	July,	1847	Coast of Africa.
America	50	Jan.,	1847	Corunna.
Childers	12	Jan.,	1847	China.
Constance	50	July,	1847	Coast of Mexico.
Conway	26	March,	1846	Isle of France.
Dido	18	May,	1847	Straits of Sunda.
Fisgard	42	Sept.,	1846	Nisqually, Oregon.
Fox	42	April,	1847	East Indies.
Racer	18	Jan.,	1847	Rio de la Plata.
Rose	18	July,	1846	Gulf of Mexico.

Observations.

The amount saved to the public Exchequer, if we refer them to parallel instances of lightning in No. I., and in which damage ensued, could not be much less than £10,000, perhaps more, and this within sixteen months. Let us now see what was the cost to the Crown for the conductors with which these ships were fitted.

By the original table given in p. 13 of Parliamentary Report, and copied into No. VIII., we have as follows:—

Two First-class Frigates, equal to two third-rates	£222
Two Second-class Frigates, equal to two fourth-rates	208
Five Sloops - - - - - - - - -	255
One Brig - - - - - - - - -	44
Total	£729

So that little more than £700 would cover the cost to the Crown for the supply of the conductors; in return, the country has saved £10,000, to say nothing of the services of the ships and the lives of the sailors.

This is a material point in any consideration of the outlay for effectually defending the Navy from lightning by a permanently fixed system of electrical conductors; moreover, this last result only applies to the case of ships once preserved by the conductors, but experience shows that the same ship may be struck by lightning several times within a few years. The "Conway" and "Racer" were, for example, both saved from danger within a few years, amply repaying any outlay for the conductors. In No. I. we find the "Eagle" 74, struck by lightning three times within a few years; the "Cumberland" 74, three times within eighteen months; in the course of which time, as before observed, she had three refits, and two new mainmasts.

CONCLUSION.

Finally, it may be as well to state explicitly what is fairly to be expected from a capacious system of electrical conductors permanently fixed in ships, and what is not.

It is certainly to be expected that the system should effectually guard against such damage as detailed in the 235 instances given, No. I.; that is, against all those violent and regular shocks of lightning falling within the ordinary experience of mankind; and that the

system is adequate to this is as certain as any very high degree of probability or assurance, depending upon a large induction of facts, can attain.

On the other hand, it is not to be expected that the system could guard against every possible kind of atmospheric electrical discharge, be the circumstances what they may; such, for example, as certain equivocal electrical discharges from the atmosphere associated with solid matter, and sometimes called thunderbolts, fire-balls, &c.; nor is it to be expected that it should effectually guard against those more palpable atmospheric discharges termed meteorlites, or against sweeping electrical actions mixed up with convulsions of nature, in which case it might be immaterial whether a ship were provided with lightning conductors or not. Neither is it to be imagined, that this system can quiet all those minor electrical effects dependent on the excited state of the general mass of the air, and the ship under the immediate influence of a thunder-cloud, and which frequently gives rise to luminous phenomena of a perfectly harmless character; nor can it always obviate that tremendous concussion and expansion of the atmosphere in cases in which a thunder-cloud discharges its lightning in a dense explosion upon the masts, and which, in common with similar mechanical effects produced by the discharge of cannon, will be sometimes severely felt by the sailors, and may rupture or tear asunder, or shake, as it were, in pieces, frangible matter. Against all this no lightning conductor can provide. Our system can only insure protection by disposing of the electrical discharge itself, the great source of destruction, and dispersing or conveying it away under the form of a non-explosive current; and this, in every instance as yet experienced, it has effected.

Taking, then, the common course of nature, as displayed in ordinary cases of ships struck and damaged by lightning, we are quite warranted in concluding, as a general truth, that a vessel armed with a system of protection, such as will render the whole mass generally non-resisting or passive, as regards the progress of the electrical discharge, would in no case experience any material inconvenience or damage; and, supposing any slight extraordinary casualty or exception to this general deduction to be within a calculable probability, still we may rest assured, as a positive certainty, that a trifling casualty occurring in any ship having such conductors, would amount to severe damage, and perhaps destruction, without them.

The foregoing pages published by Sir W. S. Harris, late in 1852, comprise many facts relating to the effect of lightning in the British Navy, and it may not be out of place here to give the Preface to the

little pamphlet published by me in 1848, as well as some of the deductions of Sir William as derived from the facts contained therein, most of which are noticed in the preceding pages :—

Preface.

The protection to ships from lightning, although a very *attractive* subject, has not elicited that practical attention which its importance deserves. The cause of humanity, not less than self-interest, demands that all ships should be furnished with properly-adjusted conductors, fixed in their places, independent of the officers and crew. My object in this publication will be to bring before the public the most prominent facts to sustain the theory and practice of Harris's conductors, and to this end I shall quote largely from the works above alluded to, not claiming any originality in the matter, but desiring only to serve the cause of humanity and economy, by introducing, if possible, the conductors in question into this country. If I succeed, I shall feel that I have "done the State some service." During some considerable experience at sea, in all climates, I have been so fortunate as never to have witnessed any very destructive effect of lightning, but I have passed many anxious moments when the lightning was flashing around, and I should have felt comparatively easy if I had been properly protected, and had faith in the means. I have always considered the common chain conductors in use in our navy, and occasionally in our merchant service, as little better than nothing; not because they "attract the fluid," but because they are so often out of place when the stroke comes, or are rendered useless by it.

A strong prejudice exists in the minds of sailors against conductors, believing that they "attract the electric fluid," which is abundantly shown in Harris's works to be imaginary; and I think there is no more reason for dispensing with lightning conductors because they *may* receive a stroke occasionally, which would pass off elsewhere without them, than for dispensing with good fires in one's house because once in a while accidents occur from them! Conductors are in general use on our houses and barns and public buildings, and it is generally admitted that they are eminently useful when properly applied; why then should the ship—a lone object on the ocean, far from any helping hand, and on an element little less dangerous than fire—be left unprotected? The answer is, simply because we have little faith in the means within our knowledge, or in general use for ships, while we have faith in the same means applied to houses and barns. We know of many ships damaged and destroyed by lightning, and there have been many lost whose fate is only known to an all-seeing Providence. All such might have been saved by properly-applied conductors, and I hope that at some future day the underwriters will have so much faith in this fact, that among the first questions asked when applied to for insurance on a ship or cargo, will be, "Has she Harris's conductors?"

I make no pretension to scientific knowledge on the subject of the

electric fluid, but I have full faith in the facts stated by Mr. Harris, whom I quote specially on the subject of conductors for ships, recommending all who feel inclined to examine his theories on the natural properties of the electric fluid, to read his work "on the nature of thunder-storms," published in London, by John W. Parker, in which the theory and practice of his conductors is fully treated and illustrated by plates.

EXTRACT FROM A LETTER OF SIR W. S. HARRIS, DATED APRIL 7, 1848, TO R. B. FORBES.

"I have yours of the 10th March, and I beg to assure you that I shall have much pleasure in using my best endeavors to forward your views relative to the application of my conductors.

"The principle and application of the conductors is very simple and easily understood, especially by inspection, but it is not so easy to perfect the application of the conductors without it. We had a great deal of trouble in carrying out the plan at first, in the Queen's Dock Yards, which is now an easy and common routine in the service. *Every ship in the British Navy is fitted*, and the East India Company has followed the example of our Government in their Indian Navy.

"I quite agree with you, as to the common chains, or other conductors of a temporary form applied as rigging,—they are neither safe nor efficient, as I have fully shown in my pamphlet. My conductors are based upon more general principles than are usually entertained in the consideration of lightning conductors generally. My object is to bring the whole mass of the ship, from truck to keel, into that perfectly conducting or passive state it would assume as regards lightning, supposing the whole were metallic throughout. To effect this, a line of copper sheet, in two layers, is incorporated with the masts, from truck to shoe, forming a series of shut joints, and so applied as to withstand any strain to which the spars may be subjected. Then we have bands of copper applied in a similar way under the beams leading to the iron knees or metallic fastenings passing through the side of the ship, and also fore-and-aft bands from the foremast to the stem, and from the mizenmast to the stern-post, whilst the conductors at the steps of the masts unite with metallic bolts passing through kelson and keel to the water, and thus the conductors at the mast-head become tied as one great connecting link with all the metallic masses in the hull, and with the sea, and it has been proved by eighteen years' experience in the British Navy, that directly as lightning strikes aloft upon the conductor all the dangerous and explosive action vanishes.

"With regard to the expense of the conductors, I have only to observe that it is reducible to the labor of fitting and interest on the outlay; the material supplied is so much *bona fide* property, always convertible into money, at the market price of copper. The conductors have saved to this country from £3,000 to £10,000 annually, in material alone, besides the safety of its fleets. We have saved, wtthin twenty months, full eight ships from whole or partial destruction, as you will see by my pamphlet, and we have, since its publication, accounts of others."

(Signed) W. SNOW HARRIS.

INTRODUCTORY OBSERVATIONS.

The Official Journals of the British Navy present, from the earliest period of its history, melancholy and often fatal instances of the destructive action of lightning. In about one hundred and twenty cases only, the amount of money sunk on account of masts and other material ruined or destroyed, cannot be set down, on a moderate computation, at less than £100,000. Three hundred seamen either lost their lives or were seriously injured, and the country was frequently deprived of the efficient services of its ships and fleets at critical periods. Between the years 1810 and 1815, we find records of no less than thirty-five sail of the line, thirteen frigates, and ten sloops, either disabled or greatly damaged. Taking into the account every instance in which ships of the Royal Navy have suffered from lightning since the war in 1793, and every expense contingent on the repairs and refit of the ships, the country did not certainly, on a moderate estimate, expend less than from £7,000 to £10,000 annually, during a period of about twenty-three years' war, and from £2,000 to £5,000 for about the same period of peace, in consequence of damage done to its navy by lightning.

A want of due attention to the means of parrying the force of the electrical discharge, may be considered as the more immediate cause of so much devastation. Our ships have either been unprovided with lightning conductors altogether, or if furnished with them, they have been of such small capacity, so partially and ill-applied, and so dependent on the prejudices of sailors, for due care and attention to them, that little benefit seems to have been derived from this source of protection.

That the common temporary forms of lightning conductor, applied as rigging, do not satisfy all the conditions of the problem, or meet the many difficult circumstances in which the general fabric of a ship, in all its casualties, may become placed, is now pretty generally admitted.

In certain cases of electrical discharge, this kind of conductor may be partially destroyed; or otherwise, from its misapplication, or from its constituting an imperfect line of discharge, or from lightning striking low down, or obliquely, upon the mast, it may fail to afford the required protection. The results of the trials resorted to by the Board of Admiralty, [1839 to 1842,] are quite conclusive upon this point, even if all former experience had not already determined the fact.*

It further appears by the medical officer's report, that the discharge fell on the deck, and disabled several of the sailors: eight men were sent to the hospital. A great portion of the discharge, however, is said to have passed off by the conductor, so far contributing to protection. These are not solitary instances; Arago, in his "Notices sur Le Tonnerre," Annuaire for 1838, p. 515, gives a similar case, as occurring in "La Junon, a French frigate, which had a rope of twisted wires applied as a lightning conductor in the rigging. In the "Comptes Rendus," for June, 1839, we find an account of damage by lightning to "l'Hotel des Invalides" at Paris, in which case the lightning conductor of twisted wire ropes was knocked in pieces. In H. M. ships "Impregnable" and "Belleisle," two line-of-battle ships, these ropes were chafed through by the working of the gear aloft, and were returned as defective to the Devonport dockyard; and these are not the only instances of this, besides others in which they have been found either misapplied or out of place. The Commission for inquiring into the best form of lightning conductors for ships, appointed in 1839 by the Board of Admiralty, under the countenance of the House of Commons, gave in their Report numerous examples of the inapplicability of these temporary expedients to meet the exigencies of a ship in storms of lightning, and to resist the violent mechanical forces to which a ship's rigging is exposed,† and concur fully in the opinion advanced by almost every practical seaman, that if lightning conductors are applied at all on shipboard, they should be applied under a capacious and permanent form, so as to render them secure, and independent of the crew of the ship for their perfect application and preservation. This has lately become an affair of no inconsiderable moment, since it is now found requisite to apply a conductor to each mast; hence it follows that the officers and seamen have to look after three conductors instead of one, as in former times, all of which is considered a great source of peril and annoyance, especially in gales of wind and in thunder-storms. But then the question arose, how far metallic conductors, of a fixed and capacious kind, can be applied so as to meet all the varying conditions of a ship's masts, and all the casualties in which the vessel itself may become placed—a problem more difficult of solution than would at first be imagined. It, in fact, amounts to this:—to construct and apply lightning conductors in ships, so as to be always in place, always ready to meet the most unexpected danger; to be permanently fixed

* See cases of "Bittern," No. 25, and "Hazard," Nos. 85 and 86, No. I.

† Shipwreck by Lightning.—Report and Evidence printed by the House of Commons, February, 1840.

and of great capacity, admitting, at the same time, not only of every possible motion of the different parts of the masts one on the other, but also of any portion of the mast being removed, either by accident or design, without in any way interfering with the protecting power; to be quite independent of the officers and crew of the ship, so as not to impose upon them the responsibility of their correct application, or the necessity of watching and handling them, of placing and replacing them in times of difficulty, to their great peril and annoyance; to be quite clear of the standing and running rigging, capable of resisting external violence, and at the same time yield to any flexure the mast can sustain; finally, to be so applied, that a discharge of lightning falling on the ship cannot enter into any circuit in its passage to the sea, of which the conductors do not constitute a part. Such are the principal conditions we have to satisfy in any attempt to effectually secure shipping against the destructive ravages of lightning.

To meet such complicated conditions the author of these remarks proposed, so long since as the year 1820, to give the ship a perfectly continuous conducting power throughout the masts and hull, by incorporating with the masts a line of double copper plates, of great electrical capacity, applied one over the other in alternating close joints, so as to yield with the flexure of the spar, being firmly embedded in a shallow groove ploughed in the after part of it. These flexible metallic lines to be finally connected with similar conductors, fixed under the beams and in the body of the ship, and connected with all the great metallic masses employed in the construction of the hull, and with the sea; thus bringing the general fabric into that peculiar electrical position it would assume, supposing the whole were metallic throughout. Thus the conductor, all the minor mechanical details being perfected, became an integral portion of the ship and masts, and the vessel consequently made secure against the violent action of lightning at all times and under all circumstances, without the officers and crew of the ship being parties to it in any way whatever.

So bold an application of the general principles of lightning conductors was not at first received without much distrust and apprehension; almost every one having been led to imagine that metallic bodies had a peculiar affinity for the matter of lightning, and by inviting or drawing it down upon the ship, frequently accelerated the mischief they were meant to obviate; that from the position of the conductors the electrical discharge would necessarily pass through the body of the hull, whilst the variable positions which the sliding masts were liable to assume would derange the line of conduction, and hence damage might ensue. The author, however, succeeded in proving by new researches in electricity, and by a very extensive induction of facts derived from the analyses of numerous instances in which ships of H. M. Navy had suffered from lightning, that such apprehensions were not tenable; that what we term lightning being nothing more than an explosive form of action of some occult power in nature when forcing its way through resisting matter, we should, in giving it a free passage through little resisting matter, transform this explosive action, termed lightning, into

a comparatively quiescent current, and so avoid those violent results arising from disruptive force altogether; that every species of matter was really in itself indifferent to the agency of lightning, which only seized upon bodies generally when they happened to be in a position to assist its progress, the course of the discharge being determined by certain laws of resistance altogether independent of any attractive power supposed to exist in them; that provision being made for the continuity of the conductor from one mast to the other, in whatever position the sliding masts were placed, a line of least resistance to the sea would be always provided; the electrical discharge would hence certainly move in that line, and in no other; and in that, too, without any intermediate explosion.

Full fifteen years' experience of these principles in H. M. Navy have proved them to be sound in science and available in practice; not only has it been found that ships thus fitted have, by the rapid transmission of electrical action, come securely and tranquilly out of most severe lightning storms in various latitudes and climates, but even in cases in which heavy and furious discharges of thunder and lightning have eventually burst on the ship, still not the least ill consequence has ensued.

It must be admitted to be a great practical fact, that whereas in former years the country expended large sums of money in repairing the damage done to its navy by lightning, and occasionally lost the full services of its ships and fleets, to say nothing of the lives of its seamen,—now, that the complete employment of the general and permanent method of conductors in the navy has been fully carried out, damage to H. M. ships by the destructive element of lightning is quite unknown.

The following remarkable instances in which capacious conductors forming a portion of the ship together with the masts, have guarded certain of H. M. ships, and those on board, against heavy shocks of lightning, may be considered as so many grand experiments on the gigantic scale of nature; they are hence of singular importance not only to the department of physical science, to which they relate, but they are also of no small consequence to the public interest and future welfare of the navy. They are hence not unworthy of a place in the records of science.

Observations made in 1846.

In reviewing these instances of the preservation of certain ships of the British Navy in thunder-storms, it is impossible not to be struck with the concurrence of various individuals in their accounts of the phenomena which they witnessed; and it is impossible not to be impressed with the importance of the fact that these statements have been made by officers in H. M. service, at intervals of several years, quite unconnected with each other, and quite uninfluenced by any personal interest. The statements are made in plain but intelligible language,

describing just what the observers witnessed, according to the common acceptation of the terms which they use, neither more nor less. Nothing, therefore, in the shape of evidence can be more perfect.

There are a few interesting facts developed in the history of these cases, which it may be worth while briefly to notice.

First.—The electrical discharge is said to have been attended by a peculiar whizzing noise, such as that produced by the escape of steam or boiling water. This phenomenon has been also noticed in other instances of thunder-storms at sea. Thus in the case of H. M. brig "Bellette" 18, struck and damaged by lightning in the West Indies, in May, 1825. Captain Leath, who commanded the brig, says, "As the lighning shot towards the earth, it caused a noise similar to the whizzing of musket balls." In this case some of the spars were shivered in pieces, and thirty-six men struck down on the deck, five of whom were seriously injured.*

Secondly.—The observers agree in stating, that the discharge is accompanied by a luminous stream, as if the lightning were running down the conductor. This phenomenon was witnessed so long since as the year 1777. A heavy stroke of lightning fell on the conductor of the Tower of Sienna, and several persons noticed upon it "a long and regular train of light." †

We have a satisfactory illustration of this phenomenon in the fact of a metallic wire appearing luminous when transmitting a progressive and intense current of artificial electricity thrown upon one of its extremities. It may, in fact, be caused to present to the eye the train of light, or other luminous appearance, termed by the observers, "lightning running down the conductor."

Now, it is to be here especially understood, that one of the great results of a pointed capacious lightning conductor, is either the mitigation of the dense shock altogether, or otherwise the reduction of it within manageable limits. If we attempt to discharge a powerful electrical battery by means of a pointed wire, two-thirds of the accumulation will, as is well known, frequently pass off before the explosion can be effected; and it will pass off as a progressive current, occupying a sensible portion of time. This is what really takes place in the action of an efficient lightning conductor upon an intense atmospheric accumulation. Before the explosion, which we term thunder and lightning, actually occurs, the conductor commences its action, and anticipates the violence of the explosion by carrying off a very considerable portion of the accumulation in an intensely progressive current; it is at this instant the luminous appearance, which the observers describe, takes place. If the conductor can, in its transmitting effort, keep pace or contend with the growing intensity of the accumulation, no explosion, such as we denominate lightning and thunder, takes place at all; and of this we have numerous instances. ‡ When, however,

* See "Nautical Magazine" for March, 1844, p. 162.
† "Tilloch's Magazine," vol. viii. p. 318.
‡ See "Minden," No. 22, No. X.

the redundant electricity of the thunder-cloud prevails, then a burst of the whole remaining charge finally occurs, and the conductor is exposed to the operation of the accumulated spark, the two actions follow closely upon each other, and are hence confounded together; we perceive the luminous effect of the first, but the second is too instantaneous to track by any result, except the impression of a vivid flash of intense light. In fact, a shock of electricity, transmitted by a conductor, moves, or is propagated through it, at the rate of 576,000 miles in a second of time; the duration of the light of the spark is about the 1,552,000th part of a second. This has been satisfactorily proved by Wheatstone's most ingenious and beautiful experiments.* The eye may receive an impression of light even from a flash enduring for so small a space of time, but it cannot track the course of an agency moving with such incredible velocity.

The stream of light thus observed upon a conductor, about the time of a shock of lightning falling on it, is of a perfectly harmless character; and must be distinguished from the actual presence of the electrical agency itself. We may cast percussion powder, and other sensitively inflammable matter, upon a wire thus luminously affected, without any ill consequence; the danger, in all cases of electrical discharge, is the repeated explosive action of the electrical agency itself in forcing its way through badly-conducting matter.

Thirdly.—The luminous effects of a heavy discharge of lightning upon the mass of the air surrounding the vessel, are again occasionally described as apparently enveloping the ship in flames, or some form of expression of this kind.

This is again a pure result of common electrical action. If a dense explosion be transmitted over or through badly-conducting bodies, or be caused to pervade them, they will frequently emit light, or glow with light, and the light will sometimes continue upon these bodies after the discharge has vanished. It is difficult to conceive an action such as that resulting from a discharge of lightning upon a conductor attached to a ship or building, without at the same time perceiving that the whole electrical condition or state of the particles of the surrounding air would be necessarily affected electrically, and give rise to those luminous effects so frequently observed in the passage of dense electrical sparks between rounded conductors. Two small balls may be so placed as to cause the intervening air to appear, by the discharges from a very powerful electrical machine, full of light, and the balls enveloped in electrical fire; like other phenomena of this kind, the luminous effect is of a harmless character.

We find, in accordance with this result, an instance in Rozier's Journal, vol. xxii., of lightning falling on the conductor of a powder magazine, in Silesia:—"The flash was seen to leave the cloud, and strike upon the rod; it appeared to envelope the whole building in electrical fire;"—a form of expression very similar to that employed in the history of the preceding cases.†

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* Philosophical Transactions.

† See cases of the "Beagle," No. 5, and "Dryad," No. 15, No. X.

Fourthly.—The violent concussion the observers describe, so common in the case of the electrical discharge striking elevated bodies, and the simultaneous descent of the lightning, with the crash of the thunder, is particularly characteristic. "I could perceive no interval of time between the flash and the thunder," observes Mr. Bonham, in his account of the "Actæon;" thus also, Mr. Sadler, with respect to the "Asia" 84, speaks of "the sudden flash, and *instantaneous* clap of thunder." Other observers speak of the concussion, as if the broadside had been fired, which is another characteristic of the electrical discharge falling on ships. Thus, in the account of the lightning which fell on the "Fisgard," the concussion is compared to the simultaneous fire of five hundred broadsides. When the "Trident" 64 was struck and damaged by lightning, in October, 1803, the log states that "the electrical discharge burst over the ship with a crash as if the main deck guns had gone off." The same thing is stated in the instance of H. M. ship "Clorinde" 44, and "Egeria" 20.—*Nautical Magazine*, June, 1843, p. 401; Nov., 1843, p. 742; and Jan., 1844, p. 28.

Fifthly.—It is important to notice the fact, that in the case of the "Scylla," lightning, both sheet and forked, exploded near the ship, without striking her at all. This has been observed in several other cases. For instance, H. M. ship "Southampton" 50, was, on the 30th June, 1842, exposed to a tropical thunder-storm. The master of the ship, Mr. Martin, states that "it lasted from 10h. P. M. to 2h. A. M., the thunder and lightning being quite incessant. The lightning struck the sea close to the ship, but no explosion occurred on the conductor." A similar case occurred in H. M. ship "Sapphire." (See Report and Evidence, &c., p. 93.) In ships, also, without conductors, we find lightning often striking upon the sea near them, as in the case of H. M. ship "Arab" 22. The log describes the electrical discharges as "thunderbolts flying about the ship, two or three of which fell in the water, within a cable's length of the ship." All this is of practical value, inasmuch as it clearly proves that the conductors only operate in carrying away the lightning when it falls on them; but they do not necessarily draw it down on the masts. We have seen how well they performed this duty in the "Fisgard," "Scylla," and others. When, however, the discharge fell on the masts of the "Arab," in the case just alluded to, which at last it did, the spars were shivered in pieces, three men were killed, and six men wounded.—*Nautical Magazine*, June, 1843, p. 394.

Upon the whole evidence, therefore, there cannot be the least doubt of the electrical discharge, in its most severe form, having fallen on most of these ships in the way described, and of their having escaped the damage usually attendant on it; and it is also evident, that the electrical agency was deprived of its explosive action from the instant of its reception by the conductor aloft, or other point on which it first struck: from that instant it existed no longer under the form of lightning. Its terribly expansive force, its irregular and explosive course, its inflammatory effect on combustible bodies, so commonly experienced in ordinary cases, are here unknown; and it may hence be fairly in-

ferred, that by means of the system of electrical conduction carried out in these ships, the British Navy, and shipping generally, may be effectually secured against the ravages of one of the most destructive and fearful elements of nature.

On a comparison of these few cases of protection with the numerous instances in which damage has occurred, the amount saved by the conductors would not be far short of £20,000, to say nothing of more vital considerations. This may be easily shown in estimating the destructive effects which might have ensued, by those which have actually resulted under similar meteorological circumstances. Thus the case of the "Fisgard" may be associated with that of the "Phæton;" the instance of the "Scylla" may be compared with the case of the "Arab," as above shown; the case of the "Asia" 84, is parallel with the case of the "Audacious" 74, struck by lightning whilst at anchor off Flushing, in August, 1810; the circumstances of the storm, winds, &c., being nearly alike, and so of the others. Now the cost of refit of these ships is known: the refit of the "Audacious," for example, including a new mainmast, amounted to a considerable sum, certainly not much less than £3,000, without taking into account the detention of the ship, and the loss of her services for six weeks.

The reader is referred to the pages of the Nautical Magazine, from June, 1843, to June, 1844, for a history of damage by lightning to the British Navy, as taken from the official journals of the ships.

The cases of the "Surinam" 18, "Trident" 64, "Clorinde" 44, "Eagle" 74, "Lowestoffe" 36, "Thisbe" 36, "Theseus" 74, and some others, furnish very marked illustrations of the dreadful havoc produced by lightning, in forcing its way through badly conducting matter.

In the case of the "Surinam," the mainmast was shivered and in its fall stove in the deck, and destroyed the cabins beneath; signals of distress were made, and the ship was nearly lost on the French coast. In the case of the "Trident," the electrical discharge is said to have burst forth from a dense black cloud right over the ship, as in the instance of the "Scylla;" it shivered the spars of the mainmast, filled the ship with smoke, and, with a suffocating smell of brimstone, burned four men severely, and so disabled the ship that she was taken in tow by one of the squadron for two days. The "Thisbe" and "Lowestoffe" were left mere wrecks on the sea; the "Eagle" 74, was in danger of being burned; and these instances may be taken as mere samples of the mass of damage recorded in all the other cases.

It may here be again observed, that the electrical agency, whatever it be, only assumes the conditions of what is commonly termed thunder and lightning, when it is determined in its course through badly-conducting matter, such as air. In pursuing its course through bodies which offer comparatively little resistance, such as the metals, it becomes robbed, as it were, of its explosive power, and exists no longer under the form of lightning; the great body of the discharge is reduced, in fact, to the condition of a comparatively quiescent current, and little luminous effect attends it, except an evanescent electrical light, of a

perfectly harmless character. The common notion that lightning is attracted towards, and brought into a ship, by conducting bodies, will be seen by these cases to be quite unfounded: where the conductor is perfectly continuous and capacious, from the highest points to the sea, the explosive action, constituting lightning, vanishes from the instant the electrical agency strikes on the conductor. Instead, therefore, of lightning being drawn down into the body of the vessel, and deposited there, as many have erroneously supposed, it is virtually prevented from coming into the ship at all.

In conclusion, it may be as well to explain what is to be fairly expected from the system of electrical conductors we have been practically considering, and what is not.

It is certainly to be expected that the conductors should provide against damage from all those violent shocks of lightning falling within the common experience of mankind; such, for example, as those which have occurred in two hundred and thirty-five instances of ships of the Royal Navy alluded to in the preceding pages as having been struck and damaged by the electrical discharge; and that the system is adequate to this is as certain as any very high degree of probability or assurance, depending on a large experience or induction of facts, can attain. The conductors have been now employed, to a greater or less extent, in ships of the Royal Navy, during a period of seventeen years* and upwards, and these have been exposed to severe thunder-storms in almost every climate and latitude in which the effects of atmospheric electricity are most to be dreaded. In India, in China, the Pacific, Halifax, and the West Indies, and in more northern latitudes;—in all these different seas has the efficiency of the system been critically and severely tested. Taking a period of about sixteen years, viz., from 1830 to 1846, during which we find this system of electrical conduction carried out, first in ten or twelve ships, and latterly in the whole Navy, not a single casualty from lightning is to be found in any one of them, nor have the ships been struck by lightning in anything like the proportion of other ships not so protected, and within a similar period of time. In cases where heavy electrical disturbances have enveloped the general mass of the vessel, and the electrical discharge has fallen on the masts under the form of thunder and lightning, it has been either parried by a rapid dispersion, or by an immediate transmission, as may be seen in the preceding cases. Of the large number of ships fitted with these conductors, not above ten instances have occurred in which they have been actually struck by lightning, and then without inconvenience or damage to the vessel, although very many instances are recorded of protection in furious thunder-storms by the influence of the conductors in rapidly dispersing intense accumulations.

Take now a similar period of time in which ships of the navy *not fitted* with such conductors have been on service, viz., from 1824 to about 1840, and it will be seen, that at least forty-five ships, averaging full one-fourth of the whole number of vessels annually at sea, have

* Now six years more.

been struck by lightning, and terribly damaged, within that time; and which, it is to be observed, includes full ten years common to both periods.

Mr. Harris says in regard to the notion that rods attract lightning,—

Amongst the objections made to the employment of lightning-rods, there appears to have been none so popular, and at the same time so plausible, as this, viz., that by setting up pointed conductors we invite lightning to our buildings, which otherwise would not fall on them; that should the quantity of electricity discharged be greater than the rod can carry off, the redundant quantity must necessarily act with destructive violence; and that since we can never know the quantity of electricity which may be accumulated in, and be discharged from, the clouds, it is not improbable but that any conductor which we can conveniently apply, may be too small for the safe conveyance of such a charge.

Although the advocates of these opinions have never adduced any substantial fact, or any known law of electricity, in support of them; although they have never, by any appeal to experience, shown that buildings armed with lightning-rods have been struck by lightning more frequently than buildings not so armed, nor demonstrated any single instance in which an efficient lightning-rod, properly applied, has failed to afford protection,—nevertheless, such views have been commonly entertained: indeed, so strenuously have they been insisted on, and that too by persons of education and influence, that the Governor-General and Council of the Honorable the East India Company were led to order the lightning-rods to be removed from their powder magazines and other public buildings, having in the year 1838 come to the conclusion, from certain representations of their scientific officers, that lightning-rods were attended by more danger than advantage; in the teeth of which conclusion, a magazine at Dum Dum, and a corning-house at Mazagon, not having lightning-rods, were struck by lightning and blown up.*

In a work on Canada, published so lately as the year 1829,† we find the following passage:—"Science has every cause to dread the thunder-rods of Franklin: they attract destruction, and houses are safer without than with them. Were they able to carry off the fluid they have the means of attracting, then there could be no danger; but this they are by no means able to do." Assertions such as these, appealing as they do to the fears of mankind, rather than to their dispassionate and sober judgment, have not altogether failed in obtaining that sort of temporary favor which so frequently attends a popular prejudice, promulgated without reason, and received without proof.

* Correspondence with the Honorable Board of Directors; Professor Daniell and Dr. O'Shaughnessy.

† *Three years in Canada.* By F. McTaggart, Civil Engineer in the service of the British Government.

Not only is the idea that a lightning-rod invites lightning unsupported by any fact, but it is absolutely at variance with the whole course of experience.

The notion that a lightning-rod is a positive evil, appears to have arisen entirely out of assumptions, and a partial consideration of facts. Thus in consequence of the track of a discharge of lightning being always determined through a certain line or lines, which upon the whole least resist its progress, it has often been found to fall in the direction of pointed metallic bodies, such as vanes, vane-spindles, iron bars, knives, &c. The instances in which these bodies seem to have determined the course of lightning have been carefully recorded, the phenomena being peculiarly striking and remarkable; but on the other hand, no attention has been given to those instances in which lightning has altogether avoided such bodies, and passed in other directions. Now it will be found, as we shall presently show, that the action of a pointed conductor is purely passive. It is rather the patient than the agent; and such conductors can no more be said to attract or invite a discharge of lightning, than a water-course can be said to attract the water which flows through it at the time of heavy rain.

We have shown, in a former section, what quantity of metal is really sufficient for the perfect conduction of any quantity of lightning liable to be discharged in the most severe thunder-storms: therefore, to assume that any conductor which may be applied is not sufficiently capacious, is to reason against experience, and to resort to a species of argument quite foreign to the conditions of the case. It would be, as if we were to insist upon the danger of applying water-pipes to buildings, under the assumption that we do not really know what quantity of rain may possibly fall from the clouds, and that hence the pipe may after all be too small to convey it.

In all these reasonings we should recollect, as already explained, that the forces in operation are distributed over a great extent of surface, and that the point or points upon which lightning strikes is dependent on some peculiar condition of the intervening air, and the amount of force in operation,—not on the mere presence of a metallic body projecting for a comparatively short distance into the atmosphere, —"that such bodies provoke the shaft of heaven is the suggestion of superstition, rather than of science."*

Before quitting the subject of the absolute protection from lightning afforded by conductors, the Naval Commission inquire, whether, according to the common prejudice, conductors have the power of *attracting* a flash of lightning, which in their absence would not have occurred; and their report states, "that the instances of accidents to ships *without conductors*, and the comparatively rare occurrence of lightning being observed to *strike* on a conductor, would tend to negative such a supposition."† They further consider, from the instances which were submitted to them, of ships without conductors having been struck by

* Leslie, *Edin. Phil. Mag.* † Report of Commission, p. 4.

lightning, in the presence of ships furnished with them, which were not so struck, that most complete evidence is afforded "either of the little influence exerted by such conductors in inducing or attracting an explosive discharge, or of their efficacy in harmlessly and imperceptibly conveying away electricity to the water."*

It may be here observed, that if lightning-rods are liable to produce lateral explosions upon surrounding bodies, so as to set fire to inflammable matter, and cause other destructive effects; then there is not a powder magazine in Europe, armed with such rods, which, upon being struck by lightning, would not either be blown up or damaged; but this at least we have shown has never been the case.

The electrical explosion which passed down the chain conductor of Her Majesty's ship "Dublin," and by which it was disjointed and partially melted, did not in any degree injure, by a lateral explosion, the small rope to which the chain was attached, nor were there any lateral discharges thrown out upon the various metallic substances near which the conductor passed.

In the numerous instances in which lightning has been discharged into the sea by the bolts in the solid timbers and planking of ships, we do not find any trace of a lateral discharge; although in large ships these bolts are several feet in length. Soon after the terrible shock of lightning had fallen upon the "Chichester," Captain Stewart thought it necessary to haul the vessel up. "I examined," says he, "the planks about the bolts, and found all quite firm and water-tight." In all the cases in which dense explosions have been transmitted by conductors fixed to the masts of ships, no lateral discharge has occurred; yet they are very near a succession of metallic bodies,—viz., sheaves and pins, funnel for rigging, iron-bound caps, eye-bolts, chain-slings, mast-hoops, and even the great masses of the chain cables and water tanks.

We have shown, by reference to a variety of cases, both the small influence of pointed conductors in attracting or causing explosions of lightning, and the liability of the discharge to break up, before reaching the earth, into two or more streams. In the cases of damage by lightning said to have occurred, notwithstanding the presence of a pointed conductor, the electrical discharge has divided in the air, into two or more streams, previously to striking the building. One portion has commonly struck upon the conductor, and been carried off by it, whilst other portions have fallen on points far distant from the conductor.

In so long a period as three quarters of a century, it is not to be expected that no casualties should occur, either from a defective application of the conductor, or from an explosion falling on some part of the building at a distance from the conductor. But the few accidents on record can scarcely be urged as an objection to the general principle, especially when we take into consideration the great number of light-

* Report of Commission, p. 4.

ning-rods set up in various parts of the world. In the United States alone, some thousands of lightning-rods have been erected since the time of Franklin's great discovery; yet only two instances are quoted in which damage occurred there, and these, as we have endeavored to show, do not warrant any distrust of the principle on which such rods are applied.

Upon a review of what has been advanced in the course of these pages, relative to the nature of thunder-storms and the operation of lightning-rods, it appears, that buildings and other elevations are struck and damaged by lightning, only in consequence of there being points in one of the terminating planes of a great electrical disturbance in the atmosphere; not from any property of attraction for the matter of lightning, inherent in the substances of which such elevations are composed:—that lightning-rods remove, by the aptness of their parts, the resistance experienced by the electrical discharge in moving through less perfect conducting matter; and hence, by allowing a rapid and free neutralization of the opposite electrical powers, they prevent the damage attendant on an obstructed action:—that the operation of such rods, being of a purely passive kind, they can no more be said to invite or draw down lightning upon the buildings to which they are applied, than a rain pipe can be said to draw down or invite the rain which flows through it:—that such a passive property cannot be fairly adduced as an argument against their general use:—that since lightning-rods only operate in transmitting as much electricity as falls on them, they cannot be prejudicial to buildings, but must, on the contrary, by a rapid annihilation either of the whole or part of the force in action, necessarily contribute to security:—that lightning, being nothing more than the electrical discharge moving through bad conducting matter, under an explosive form, the tendency of a lightning-rod is to deprive the discharge of this form from the instant it falls on the point of the rod, and by converting it into an evanescent current, through matter calculated to assist its progress, to annihilate it as lightning altogether.

In the treatment of this question, it was not possible to avoid a frequent appeal to electrical action, on the great scale of nature. If, therefore, the remarkable instances quoted, of lightning striking on buildings and ships, should appear to be somewhat numerous, and to be treated of in too great detail, yet it must be recollected, that it is only by pursuing such a course that we can hope to arrive at deductions worthy of confidence. Hence it is, that in the progress of these inquiries we have been led to adhere carefully to a series of well-authenticated facts, and by keeping strictly within the safe path of inductive science, we have endeavored to throw some further light on a subject of very great public importance, which has not been generally or fully appreciated. With respect to certain prejudiced views and opinions which have been entertained of the operation of lightning-rods, we trust to have made it appear, that such opinions are founded on no sound basis whatever; and that a judicious application of pointed conductors, both on land and at sea, is not only desirable, but is in a great

variety of cases quite essential to the preservation of buildings and ships from the ravages of lightning.

Sir William Harris has very justly assumed that high credit to which he is entitled of having effectually protected the ships of H. M. Navy from lightning, the effects of which he has shown in the pages of this journal (previous to the application of his conductors) produced the most disastrous results among them in all parts of the world. Doubtless it was a bold, even an unprecedented step, to lead this destructive agent fearlessly through a ship of war, crowded with life, in the very midst of those well-known combustible materials which are essential to her duties; and his plan was received, as might be expected, with prejudice. But the measure was founded on sound principles of science, and, seeing that it had the support of such persons as Sir Humphrey Davy, Dr. Wollaston, and other leading practical men of the day, we at once accorded to him the assistance of this journal to make known his theory, and his plan for carrying it out in the defence of our navy. The result has fully rewarded our expectations: the loss of life, or the destruction of spars, from the effects of lightning, is no longer known in the British Navy, and if a solitary instance should occur, it turns out that the vessel has, from some accidental cause, not been fitted with the conductors of Sir W. Harris. For our own part, we congratulate, most sincerely, not only Sir W. Harris, who has effected it, but our seamen and officers, as well as the country at large, who have been benefited by this great achievement, in the successful application of scientific research to so important a purpose, the good effects of which, at a critical moment, it would be difficult to overrate. And we look back at the course which we adopted, when Sir William Harris's views were opposed by others who knew less of the subject than he did, with feelings of satisfaction approaching to exultation at the complete success which has crowned his exertions; rejoicing that while the avowed object of our pages is to warn the navigator of hidden dangers which lie in his path, they have been also the medium of promulgating, throughout the maritime world, an effectual defence of his ship from another danger which has proved itself to be equally as fatal to him as the former.—*Nautical Magazine*, March, 1853.

I cannot conclude these pages without entering my protest against the location often adopted for pumps — they are sometimes placed just before the mainmast, so that a stroke of lightning falling on it is likely to come down by the topsail sheets and to pass down by the pumps, particularly if they are of metal, and if the gear is left in them. The more usual place, near the after part of the mast, is objectionable, though not in the same degree, and I prefer to have pumps at the forward end of the after hatch, and so fitted that the pump-well can be entered from the hatch at all times without hoisting out the pumps, or breaking out cargo.

R. B. FORBES.

NOTE.—The *Nautical Magazine*, beginning with the May number of last year, and coming down to November or December, contains a full "Review of the History and Progress of a System of Permanently Fixed Conductors for H. M. Ships, from the Year 1820, when first Proposed, to the Present Year, when Fully Adopted into the Public Service. By Sir W. Snow Harris, F. R. S."

These papers are well worth reading, and contain many facts and deductions from them not contained in these pages.

R. B. F.

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